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Utah Lake-Jordan River Water Quality Management Planning Study

Environmental Protection Agency

Prepared For
Nelson, Haley, Patterson and Quirk, Inc., Denver, Colorado

Apr 76

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DRAFT ENVIRONMENTAL IMPACT STATEMENT

FOR

UTAH LAKE-JORDAN RIVER WATER QUALITY MANAGEMENT PLANNING STUDY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII DENVER, COLORADO

APRIL 1976

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The enclosed draft environmental impact statement for the Utah Lake - Jordan River Water Quality Management Planning Study is given in the report. The basic purpose of the Utah Lake-Jordan River Water Quality Management Planning Study was to develop a comprehensive plan for determining the direction of future water quality control activities within the Basins. The Plan complies with Federal regulations for basin plans as defined in Section 303(e) of PL 92-500; a prerequisite to the award of Federal grants for construction of wastewater treatment facilities. Additionally the Plan identifies and describes the physical facilities required to attain the water quality standards established by the State of Utah.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VIII
1860 LINCOLN STREET
DENVER, COLORADO 80203

MAY 14 1976

TO ALL INTERESTED GOVERNMENT AGENCIES, PUBLIC GROUPS, AND INDIVIDUALS

The enclosed draft environmental impact statement for the Utah Lake - Jordan River Water Quality Management Planning Study is submitted for your review and comments in accordance with the National Environmental Policy Act of 1969.

[illegible]
the report, p.

This Water Quality Management Plan is being considered for approval by EPA. All comments from Federal, State and local agencies, as well as private groups and individuals received within 45 days of the date of this letter will be considered in preparation of the final environmental impact statement for this action.

In order to receive public comments, the Environmental Protection Agency, Region VIII, will hold a public hearing on the draft EIS on June 10, 1976 at 2:00 p.m. and 7:00 p.m. in the Salt Palace, Suite A, 100 South West Temple, Salt Lake City, Utah. All interested parties are invited to express their views at this hearing. Persons wishing to make comments may submit same in writing to EPA at the above address and/or appear at this hearing. For the purpose of accuracy of the record, it would be appreciated if oral statements were accompanied with a written statement. Oral statements should summarize any extensive written materials so that there will be time for all interested persons to be heard.

John A. Green

John A. Green
Regional Administrator

DRAFT ENVIRONMENTAL IMPACT STATEMENT

for

UTAH LAKE-JORDAN RIVER WATER QUALITY MANAGEMENT PLANNING STUDY

Prepared by

U. S. Environmental Protection Agency
Region VIII Denver, Colorado

and

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Approved by

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April, 1976
Date

UTAH LAKE-JORDAN RIVER WATER QUALITY MANAGEMENT PLANNING STUDY

(X) DRAFT ( ) FINAL

ENVIRONMENTAL PROTECTION AGENCY
REGION VIII DENVER, COLORADO

1. Name of Action: (X) ADMINISTRATIVE ( ) LEGISLATIVE

2. Description of Action: The Utah Lake-Jordan River Water Quality Management Planning Study consists of a series of proposed wastewater treatment alternatives to resolve water pollution problems in all or parts of Davis, Salt Lake, Utah, Wasatch, and Juab Counties in the State of Utah.

3. Environmental Impacts: Environmental impacts are presented in terms of impacts on water quality, land resources, and air quality, as well as economic, financial, and social impacts. Water quality impacts are presented in Chapter IV, land resource impacts together with economic, financial, and social impacts are presented in Chapter V, and air quality impacts are presented in Chapter VI. Unavoidable adverse impacts are presented in Chapter VIII and mitigating measures are presented in Chapter IX.

4. Alternatives: Approximately 12 wastewater treatment alternatives were considered for several sub-areas of the Utah Lake-Jordan River Basins. These sub-areas are Davis County, Salt Lake County, Northern Utah County, Central Utah County, and Wasatch County. These alternatives are presented in Chapter III.

5. Distribution: The Distribution List presented on page v contains the names of all the agencies, groups, and individuals requested to comment on this draft environmental impact statement.

6. Draft Environmental Impact Statement sent to Council on Environmental Quality: February 1976.

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[3] Copies will be circulated to member cities.

FOREWORD

This environmental impact statement (EIS) is the end result of a decision by EPA to issue a full scale EIS on the Utah Lake-Jordan River Water Quality Management Planning Study.

This report is organized into 11 chapters dealing with the background, facility alternatives, and environmental impacts. A separate summary document containing the key issues has been prepared for those readers intimidated by the volume of material presented. The detailed environmental impacts are presented in Chapters IV, V, and VI and are divided into water, land, and air resources for ease of presentation.

Much of the material presented herein is a summary of detailed information contained in the Study Task Report Series submitted under separate cover to EPA.

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- Davis County Planning
- State Department of Highways

- Salt Lake County Planning Department
- U. S. Soil Conservation Service
- U. S. Forest Service (Wasatch and Uinta Forests)
- Orem Planning Department
- Utah County Planning Department
- Provo Planning Department
- Spanish Fork
- Nephi
- Bountiful Planning Department
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- Utah Taxpayers Association
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- Bob Britzman
- Annemarie Bleiker
- Hans Bleiker
- Carol Cromwell

CHAPTER I

INTRODUCTION

UTAH LAKE-JORDAN RIVER WATER QUALITY MANAGEMENT PLANNING STUDY

Historically, management of the natural environment was the charge of segregated agencies and institutions whose responsibilities were typically isolated to a particular area of concern. However, as natural resources have dwindled, a greater emphasis on management of resources has occurred. Water quality management has come to the forefront as a critical resource management issue. In 1965, Congress enacted amendments to the Federal Water Pollution Control Act. Section 3(c) of the Act provided for comprehensive water quality management planning. Further amendments in 1972 (PL 92-500) required the development of basin plans (Section 303(e)).

In December 1971, the Utah Division of Health, Environmental Health Services Branch undertook a major water quality management study for the Utah Lake-Jordan River Hydrologic Basins, illustrated in Figure I-1. The resulting plan was completed and submitted to the U. S. Environmental Protection Agency (EPA) in September 1974.

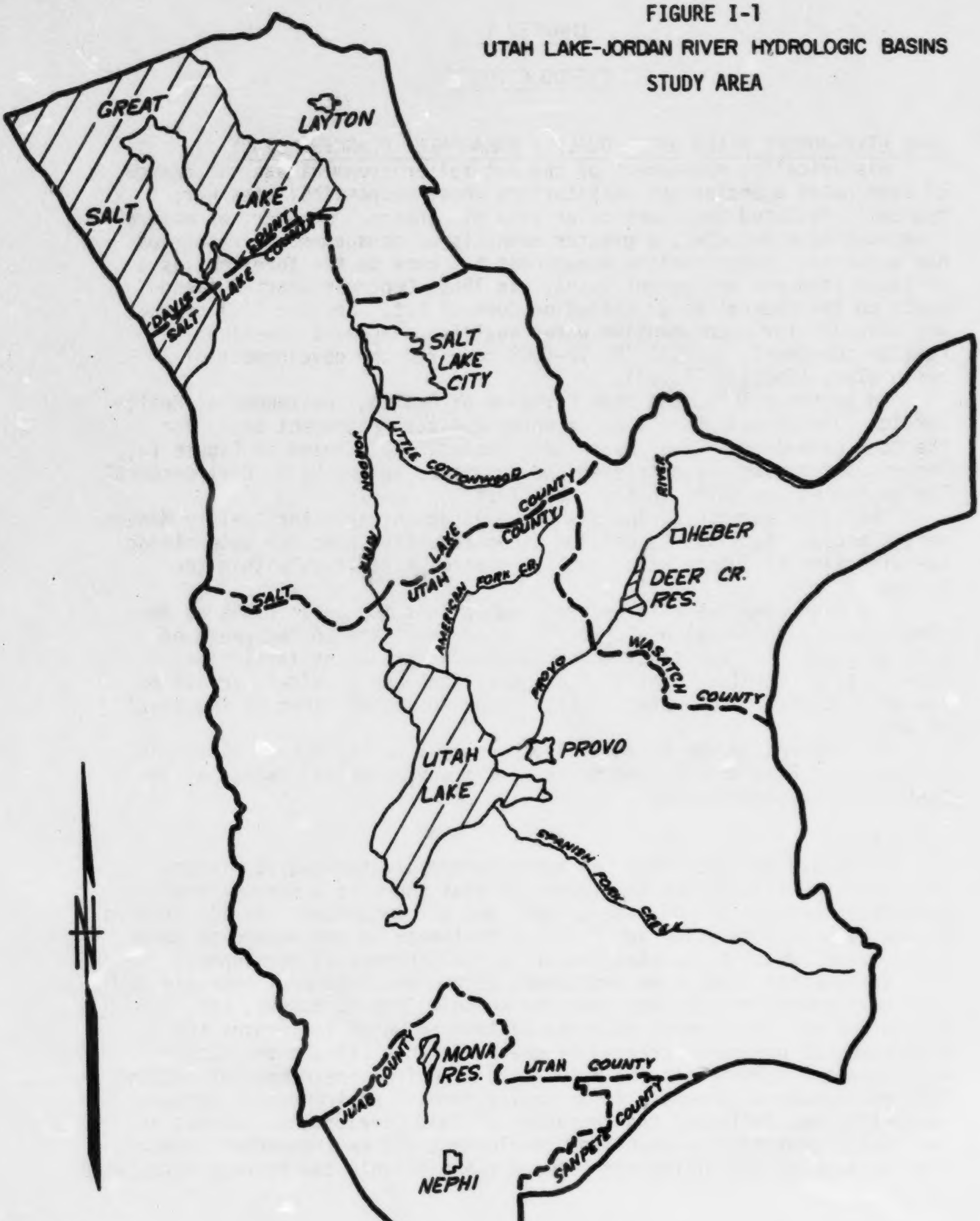
The basic purpose of the Utah Lake-Jordan River Water Quality Management Planning Study was to develop a comprehensive plan for determining the direction of future water quality control activities within the Basins.

The Plan complies with Federal regulations for basin plans as defined in Section 303(e) of PL 92-500; a prerequisite to the award of Federal grants for construction of wastewater treatment facilities. Additionally the Plan identifies and describes the physical facilities required to attain the water quality standards established by the State of Utah.

As required by the National Environmental Policy Act of 1969, EPA reviewed the Plan and decided to issue the environmental impact statement (EIS) presented herein.

EIS CONTEXT

It should be clear from the socio-economic/water quality interrelationships illustrated in Figure I-2 that there is a strong interdependence between use of water, land, and air resources. As illustrated in the Figure, population has a direct influence on the demand of goods and services which stimulates industrial and commercial development. This stimulation creates an employment demand and a general increase in land development through the need for schools, roads, houses, etc. Population and development generate wastewater which influences the environmental pressures created by the difference between the actual environmental setting and the population's desired environmental setting. This environmental pressure is decreased through environmental management which may influence the character of land development. Stress is constantly generated between land development and environmental management because of the difference between the available tax revenue associated


GREAT
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LAKE
LAYTON
DAVIS
COUNTY
SALT
LAKE
COUNTY
SALT
LAKE
CITY
LITTLE COTTONWOOD
JORDAN
RIVER
SALT
LAKE
COUNTY
UTAH
COUNTY
AMERICAN FORK CR.
RIVER
HEBER
DEER CR.
RES.
PROVO
WASATCH
COUNTY
PROVO
UTAH
LAKE
SPANISH FORK CREEK
MONA
RES.
JUAB
COUNTY
UTAH
COUNTY
SANPETE
COUNTY
NEPHI
N

FIGURE I-1
UTAH LAKE-JORDAN RIVER HYDROLOGIC BASINS
STUDY AREA

by: NHPQ

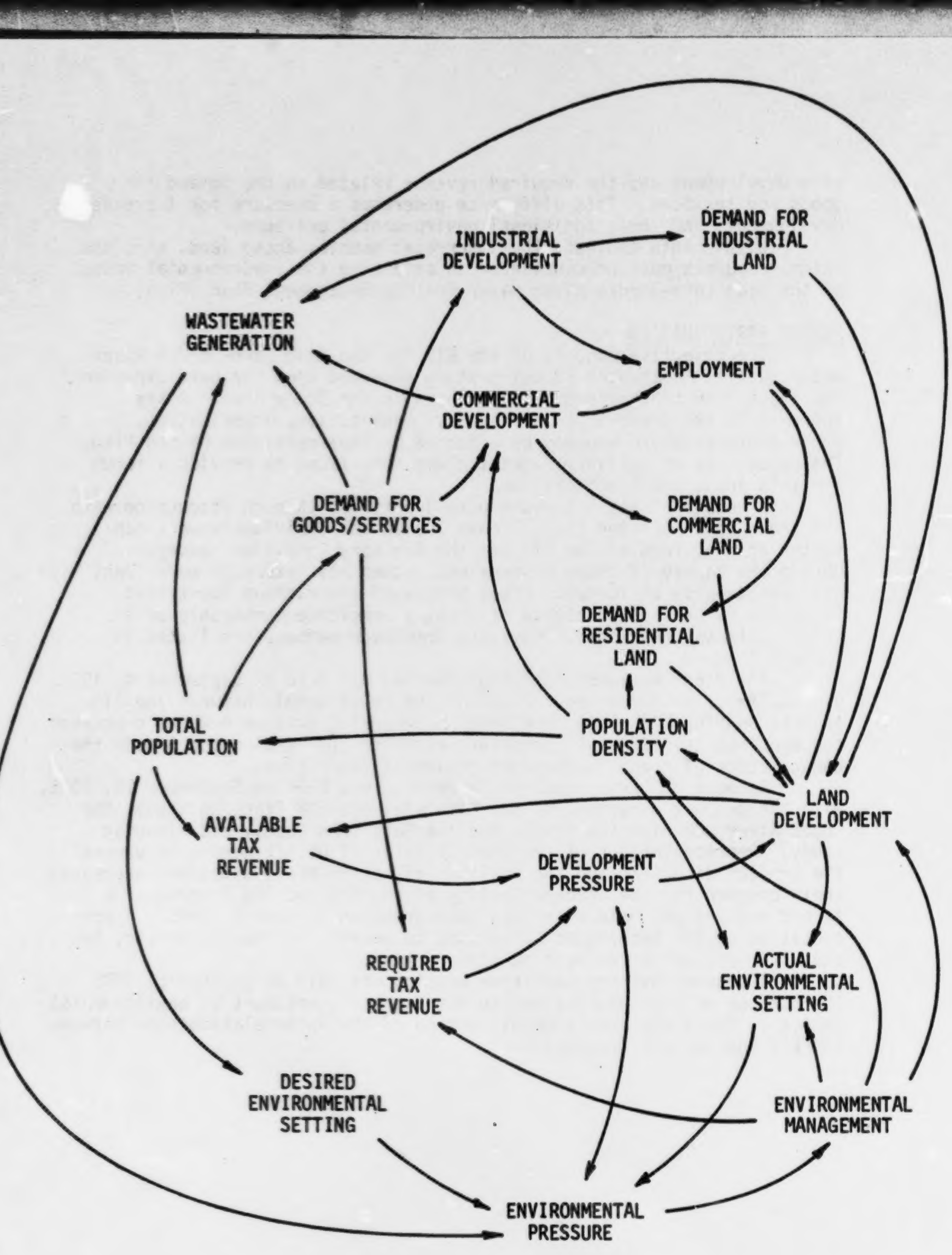
DEMAND FOR INDUSTRIAL LAND
INDUSTRIAL DEVELOPMENT
WASTEWATER GENERATION
EMPLOYMENT
COMMERCIAL DEVELOPMENT
DEMAND FOR GOODS/SERVICES
DEMAND FOR COMMERCIAL LAND
DEMAND FOR RESIDENTIAL LAND
TOTAL POPULATION
POPULATION DENSITY
LAND DEVELOPMENT
AVAILABLE TAX REVENUE
DEVELOPMENT PRESSURE
REQUIRED TAX REVENUE
ACTUAL ENVIRONMENTAL SETTING
DESIRED ENVIRONMENTAL SETTING
ENVIRONMENTAL MANAGEMENT
ENVIRONMENTAL PRESSURE

FIGURE I-2

SOCIO-ECONOMIC/WATER QUALITY INTERRELATIONSHIPS with development and the required revenue related to the demand for goods and services. This difference generates a pressure for increased development, and thus, additional environmental pressure.

Within this context, the interrelationships among land, air, and water resources must be considered in assessing the environmental impact of the Utah Lake-Jordan River Water Quality Management Plan (Plan).

PUBLIC PARTICIPATION

The effective conduct of the EIS for the Utah Lake-Jordan River Water Quality Management Planning Study depended upon the participation and input from the various key interests in the Study Area. A key interest is perceived to be any agency, institution, organization, or other representative who may be effected by implementation of the Plan. The concept of an Advisory Committee was formulated to provide a forum for this input and participation.

A number of key interests were identified through discussion with EPA and a review of the Plan. These groups and individuals were contacted and informed of the EIS and the Advisory Committee concept. During the course of these discussions, other key interests were identified and subsequently contacted. After review of the various identified interests by EPA and the State of Utah, a Committee membership of 14 individuals was developed. Advisory Committee members are listed in Table I-1.

The first Advisory Committee meeting was held on September 4, 1975. Discussion at this meeting focused on the relationship between the EIS and the ongoing 208 planning efforts. Several Committee members expressed concern that the EIS would interfere with the 208 studies and impede the construction of needed wastewater treatment facilities.

Because of these concerns, a meeting was held on September 19, 1975, with the project directors of the Mountainlands 208 Planning Study, the Weber River 208 Planning Study, and the Salt Lake County 208 Planning Study. Representatives of the Utah Division of Health were also present. The project directors and the Division of Health representatives expressed their concern for the incompatibility of the EIS and 208 Programs. A second meeting was held with this same group on October 6, 1975. A presentation of the techniques being used to assess the impacts on air, land, and water resources was made at this meeting.

A second Advisory Committee meeting was held on October 6, 1975. The purpose of this meeting was to discuss the assessment of environmental impacts. There was also some discussion of the interrelationships between the EIS and the 208 Programs.

TABLE I-1

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CHAPTER II

BACKGROUND

SOCIAL SETTING

History

The first white men in recorded history to enter Utah Valley were Spanish explorers led by Francisco Antanasio Dominguez and Silvestre Velezde Escalante. They entered the Valley through Spanish Fork Canyon on September 23, 1776. During the early nineteenth century, English and American trappers explored the Utah and Salt Lake Valleys. Among these early explorers were William H. Ashley and Entienne Provost sent by the Rocky Mountain Fur Company to explore and trap mink and beaver. John C. Fremont passed through the Valley in 1843.

A small party of Mormon pioneers led by Brigham Young entered the Salt Lake Valley on July 24, 1847, to establish a permanent settlement. In spite of the lateness of the season, crops were planted, irrigation systems established, and crops harvested that fall. Within two years, Salt Lake City had a population of 5,000 and became one of the fastest growing communities in the West. The town was laid out in square 10-acre blocks that were oriented in north-south and east-west directions. Wide streets were provided between the blocks, and areas were set aside for parks, churches, businesses, and similar uses at the time the city was laid out. Most of the roads in the area are still square with the cardinal points of the compass.

Brigham Young, president of the Mormon Church, sent an exploration party into southern Utah County in 1847. In 1849, John S. Higbee, who had been in the first exploration party, and 30 families, about 150 people, built Fort Utah along the Provo River, about 2.5 miles west of the center of the present City of Provo. The fort wall was 14 feet high and the log houses were on the inside. Small settlements, or towns, were soon established about 6 miles apart for a distance of about 50 miles. These settlements were Mountainville (Alpine), Lehi City, American Fork, Battle Creek (Pleasant Grove), Provo City, Springville, Palmyra City (Spanish Fork), Payson, and Summitville (Santaquin). The people lived within the town limits and farmed areas outside the towns.

The Union Pacific Railroad was completed on November 18, 1873, and the Denver and Rio Grande Western Railway in 1889.

The first newspaper, The Provo Daily Times, was published in the territory south of Salt Lake in 1872.

Members of the Church of Jesus Christ of Latter-Day Saints (Mormon Church) were leaders in the settlement of the Study Area. However, with the discovery of gold in California, came an influx of miners, soldiers, and settlers. Thus developed many years of conflict, both philosophical and physical, involving marital law, anti-Mormon legislation, court expropriation of Church property, and delay of statehood.

Culture

The early Mormon struggles and persecution have resulted in a unique cultural and political heritage which is manifested today in

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the Study Area. There is a strong group and family solidarity. People in the Study Area prefer to "take care of themselves." Politically, this has been translated into a strong anti-Federal government outlook. Indeed, Jake Garn, former mayor of Salt Lake City, was elected to the U. S. Senate in 1974, after campaigning on a platform of keeping the federal government out of the State's business.

Because of the strong Mormon influence, there is a tremendous willingness to work hard and to achieve success in all productive endeavors. Mormon principles decry idleness, waste, and luxury, advocate hard, continuous labor, and encourage financial success. These principles have been responsible for strong pro-development feelings among certain sectors of the populace.

As is the case with many other parts of the United States, religious ties are weakening in the Study Area, particularly in the cities. However, the Mormon Church remains a potent influence in shaping the culture of the Utah Lake-Jordan River area.

In the political arena, Democrats presently control both houses of the state legislature for the first time in many years. Governor Calvin L. Rampton, also a Democrat, was re-elected to a third term in 1974. It would appear that the usual liberal-conservative issues and divisions do not fully apply in Utah. There is a strong element of extreme conservatism within the State. Conservative factions, together with land developers and realtors, were considered responsible for defeating a land use bill passed by the legislature in 1973 and referred to the people.

Population Centers

According to the 1970 Census of Population, the total 1970 population of the Study Area was 718,638 persons. This is estimated to be 68 percent of the 1970 population of Utah. Salt Lake County, with a 1970 population of 458,607, has the greatest concentration of population in both the Study Area and the State. Utah County is second in population with 137,776 persons, followed by Davis County with 99,028. The remainder of the Study Area, including portions of Wasatch, Juab, Sanpete, Weber, and Summit Counties have a reported 1970 population of 23,227. The relative populations of these areas are illustrated in Figure II-1.

Local Governments/Agencies

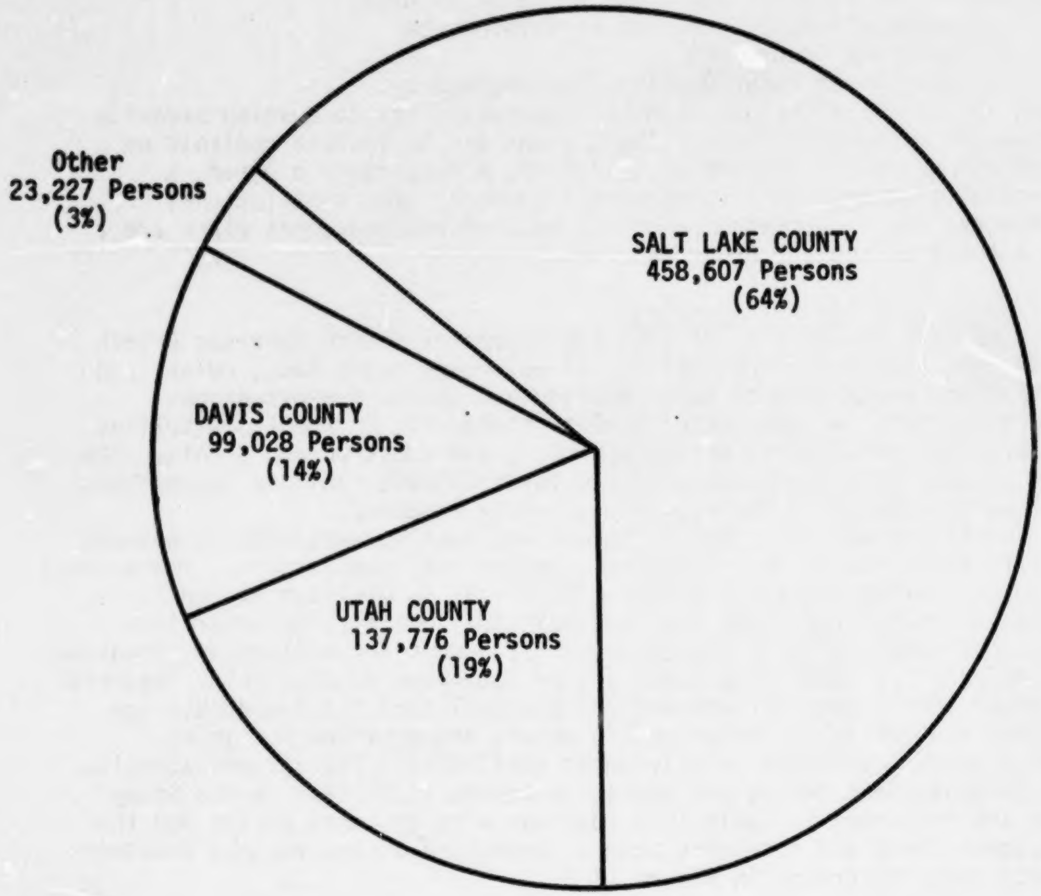
Planning Agencies

Land use planning within the Study Area is influenced primarily by the State, various councils of government, the counties, and city governments. Only the county and city governments have actual regulatory controls. The State agencies:

- Office of the State Planning Coordinator
- Division of Highways

and the council of governments (COG):

- Wasatch Front Regional COG
- Mountainland Association of Governments
- Salt Lake County COG



STUDY AREA POPULATION DISTRIBUTION

FIGURE II-1

normally are involved in developing regional policies, plans, and projections. Except for the Division of Highways, these plans are rarely implementable by the agency.

Under current statuatory authority, the city and county planning agencies are permitted to develop land use plans and regulatory controls. Land use regulation is not a statuatory requirement, but rather a local option.

In terms of water quality planning, there are currently three 208 Water Quality Management Planning programs underway in the Study Area. Water quality management planning grants under Section 208 of PL 92-500 have been given to three agencies in the Study Area:

- Mountainlands Association of Governments
- Salt Lake County COG
- Weber River Water Quality Planning Agency.

These agencies are charged with the responsibility to develop areawide wastewater management plans. These plans are to include controls on point and non-point sources of pollution, a regulatory program, a financial program, and a management framework. The institutional frameworks for implementation of the wastewater management plans are a key element of the 208 Programs.

Wastewater Control Agencies

The Utah Division of Health, Environmental Health Services Branch is charged with the responsibility of enforcing State laws, rules, and regulations pertaining to water quality and wastewater discharges. Generally, this includes water quality standards, effluent limitations, construction priorities, design approval, and construction grants. The State agency also has responsibility for treatment facility inspection, but operator certification is not currently required.

State statuatory authority to own and operate wastewater treatment facilities is vested in any county, incorporated municipality, improvement district, taxing district, or other political subdivision of the State. State law grants the right for such political entities to enter into long-term contracts with any other public owners for collection, treatment and disposal of sewage; to construct or otherwise acquire joint interests in sewer lines, sewage treatment and disposal facilities and sell any portion thereof to any other public owner; and provides for joint operation of any of the jointly owned facilities. The various agencies and jurisdictions owning and operating sewage facilities in the Study Area are presented in Table II-1 together with the area served and the treatment plant and receiving water. Locations of the various treatment plants are illustrated in Figure II-2.

Land Use Patterns

Land within the Study Area is owned by the Federal and State governments and many private entities and individuals. Federal lands are managed by the U. S. Forest Service, U. S. Bureau of Land Management, and the U. S. Department of Defense. The State of Utah owns numerous parks, wildlife refuges, and recreation areas. Private land is held by cities, railroads, industries, churches, and individuals. The distribution of land ownership in the Study Area is illustrated in Figure II-3.

TABLE II-1

WASTEWATER AGENCIES AND TREATMENT PLANTS

County	Agency	Area Served	Treatment Plant	Receiving Water	Map(1) Index
Davis	North Davis County Sewer District	Clearfield East Layton Roy Syracuse West Point Sunset Layton Clinton	North Davis County Sewer District	Great Salt Lake	1
	Central Davis County Sewer District	Farmington Kaysville Fruit Heights	Central Davis County Sewer District	Haight Creek	2
	South Davis County Sewer District	Bountiful North Salt Lake	South Davis County Sewer District - North Plant	State Canal	3
		Bountiful West Bountiful Woods Cross Centerville	South Davis County Sewer District - South Plant	Jordan River	4
Salt Lake	Salt Lake City	Salt Lake City	Salt Lake City	Sewage Canal	5
	Chesterfield Improvement District	South Salt Lake City	South Salt Lake City	Jordan River	6
	Granger-Hunter Improvement District	Hunter Kearns Granger	Granger-Hunter Improvement District	Jordan River	7

TABLE II-1 (Continued)

WASTEWATER AGENCIES AND TREATMENT PLANTS

County	Agency	Area Served	Treatment Plant	Receiving Water	Map$^{(1)}$ Index
Salt Lake (Con't)	Salt Lake City Suburban Sanitation District No. 1	Taylorsville-Bennion Improvement District	Salt Lake City Suburban Sanitation District No. 1	Vitro Waste Ditch	8
	Salt Lake County Cottonwood Sanitation District	Snowbird Cottonwood Area	Salt Lake County Cottonwood S.D.	Big Cottonwood Creek	9
	Murray City	Murray	Murray	Jordan River	10
	Salt Lake County Sewerage Improvement District No. 1	Bluffdale Draper Riverton South Jordan Salt Lake City SSD-2 Midvale West Jordan	Tri-Community	Jordan River	11
	Sandy Suburban Improvement District	Sandy	Sandy	Jordan River	12
	Magna Water & Sewer Improvement District	Magna Area	Magna	Kersey Creek	13
	Copperton City	Copperton	Copperton	Waste Canal	14
	Lark Sewer and Water Corporation		Lark	Keystone Gulch	15
	State of Utah	Utah State Prison	Utah State Prison	(2)	16
	U.S. Government	Camp Williams	Camp Williams	(2)	17

TABLE II-1 (Continued)

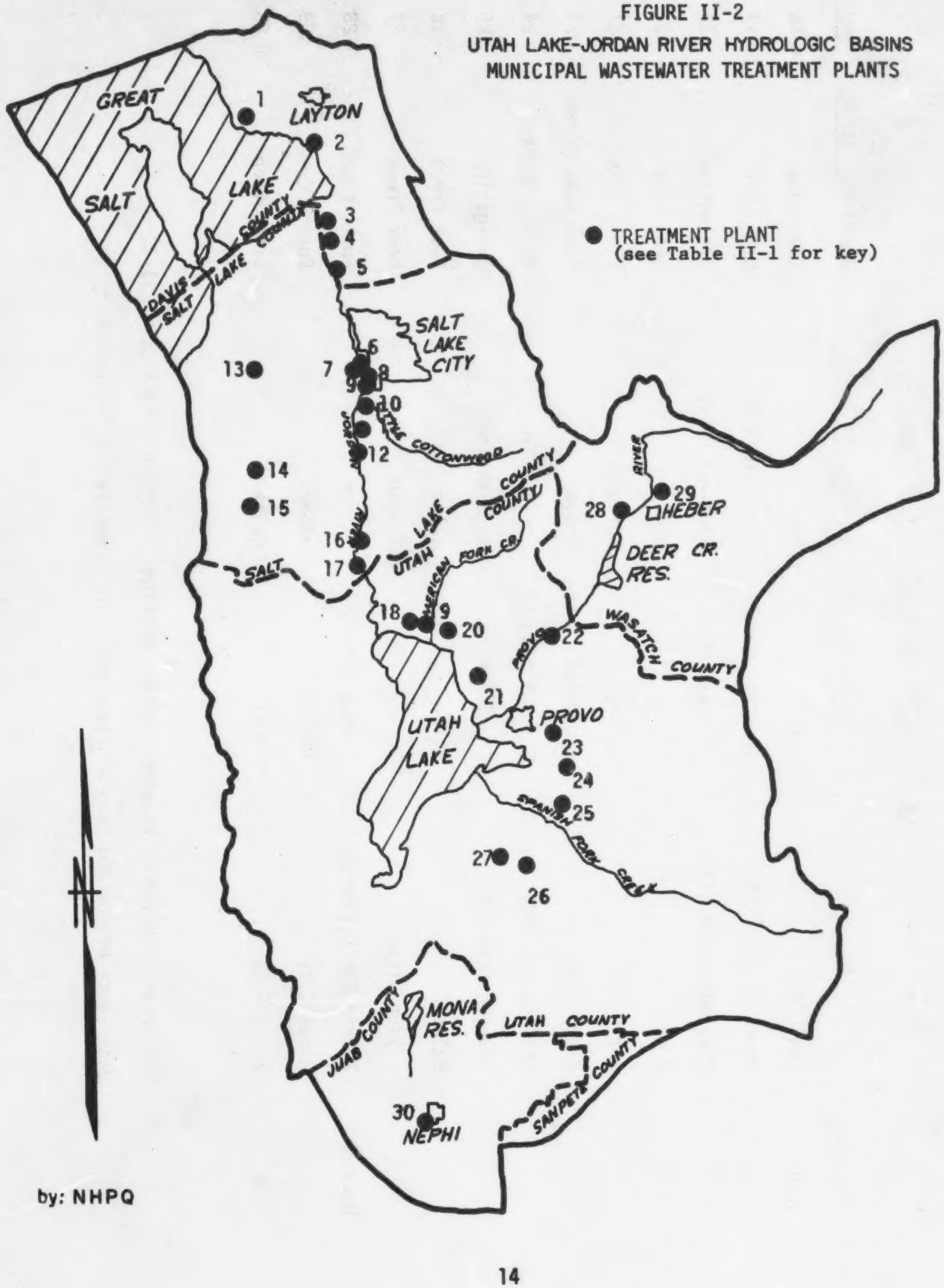
WASTEWATER AGENCIES AND TREATMENT PLANTS

County	Agency	Area Served	Treatment Plant	Receiving Water	Map(1). Index
Utah	Lehi City	Lehi	Lehi	Utah Lake	18
	American Fork City	American Fork	American Fork	Utah Lake	19
	Pleasant Grove City	Pleasant Grove	Pleasant Grove	Irrigation	20
	Orem City	Orem	Orem	Utah Lake	21
	Springdell	Springdell	Springdell	Provo River	22
	Provo City	Provo Area	Provo	Mill Race Stream	23
	Springville City	Springville	Springville	Spring Creek	24
	Spanish Fork City	Spanish Fork	Spanish Fork	Irrigation	25
	Salem City	Salem	Salem	Beer Creek	26
	Payson City	Payson	Payson	Beer Creek	27
Wasatch	Midway Sanitation Dist.	Midway Area	Midway	Snake Creek	28
	Heber City	Heber	Heber	Spring Creek	29
Juab	Nephi City	Nephi	Nephi	Irrigation	30

NOTES:

1. Map index is keyed to treatment plant locations illustrated in Figure III-2.
2. Utah State Prison and Camp Williams are being connected to Tri-Community.

FIGURE II-2
UTAH LAKE-JORDAN RIVER HYDROLOGIC BASINS
MUNICIPAL WASTEWATER TREATMENT PLANTS


● TREATMENT PLANT
(see Table II-1 for key)
GREAT SALT LAKE
LAYTON
DAVIS COUNTY
SALT LAKE COUNTY
SALT LAKE CITY
JORDAN RIVER
LITTLE COTTONWOOD
SALT LAKE COUNTY
UTAH COUNTY
AMERICAN FORK CR.
RIVER
HEBER
DEER CR. RES.
PROVO
WASATCH COUNTY
UTAH LAKE
PROVO
SPANISH FORK CREEK
MONA RES.
JUAB COUNTY
UTAH COUNTY
SANPETE COUNTY
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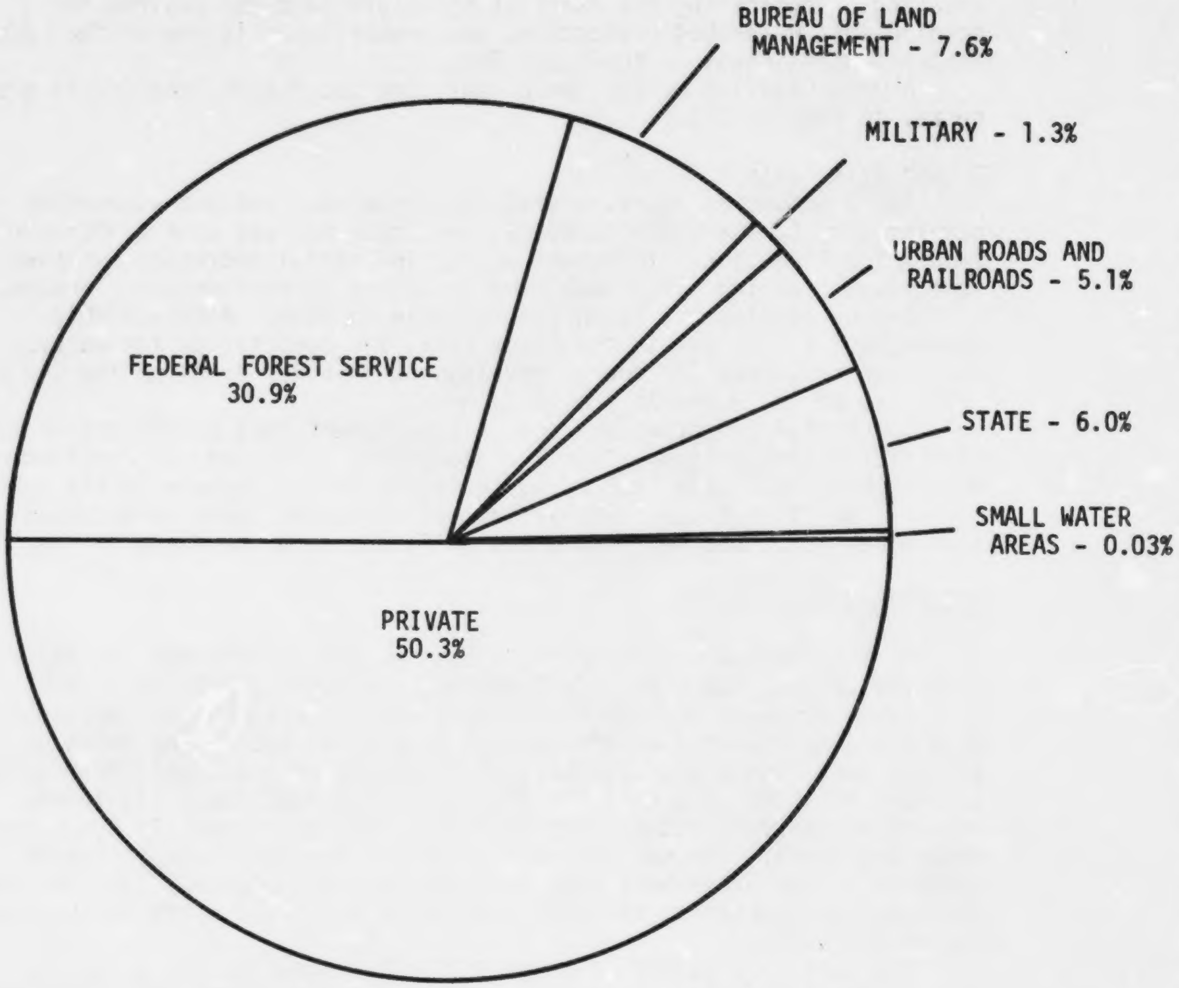
by: NHPQ



PRESENT LAND OWNERSHIP

FIGURE II-3

The existing land use distribution is illustrated in Figure II-4. Approximately two-thirds of the Study Area land is occupied by forests and mountain areas. Within the developed areas, agriculture is the predominate land use, with 16.7 percent of the total land area.

The canyons and mountain lands are used extensively for winter and summer recreation as well as a water supply source. Residential development of the canyons is minimal, however development pressure is increasing. Reconciling the conflicting future land use desires for development, watershed protection, and preservation is one of the major environmental issues in the Study Area.

A more detailed discussion of existing and future land use is presented in Chapter III.

Growth Stimulants

For a number of years, a specific State goal was the attraction of new industry to the State. Indeed, the State has set up a Division of Industrial Promotion. In recent years, industrial promotion has been selective, planning for growth, and sensitive to environmental issues.

Energy development is on the increase in Utah. Although this development is minimal in the Study Area, the competition for natural and human resources for energy development in other parts of the State will have an influence in the Study Area.

Industrial promotion and energy development must be thought of as significant growth stimulii in the Study Area. However, as development occurs there will be a loss of agricultural land. Because of the strong cultural feelings towards stewardship of the land, these dichotomous development stresses may become a significant land use issue in the future.

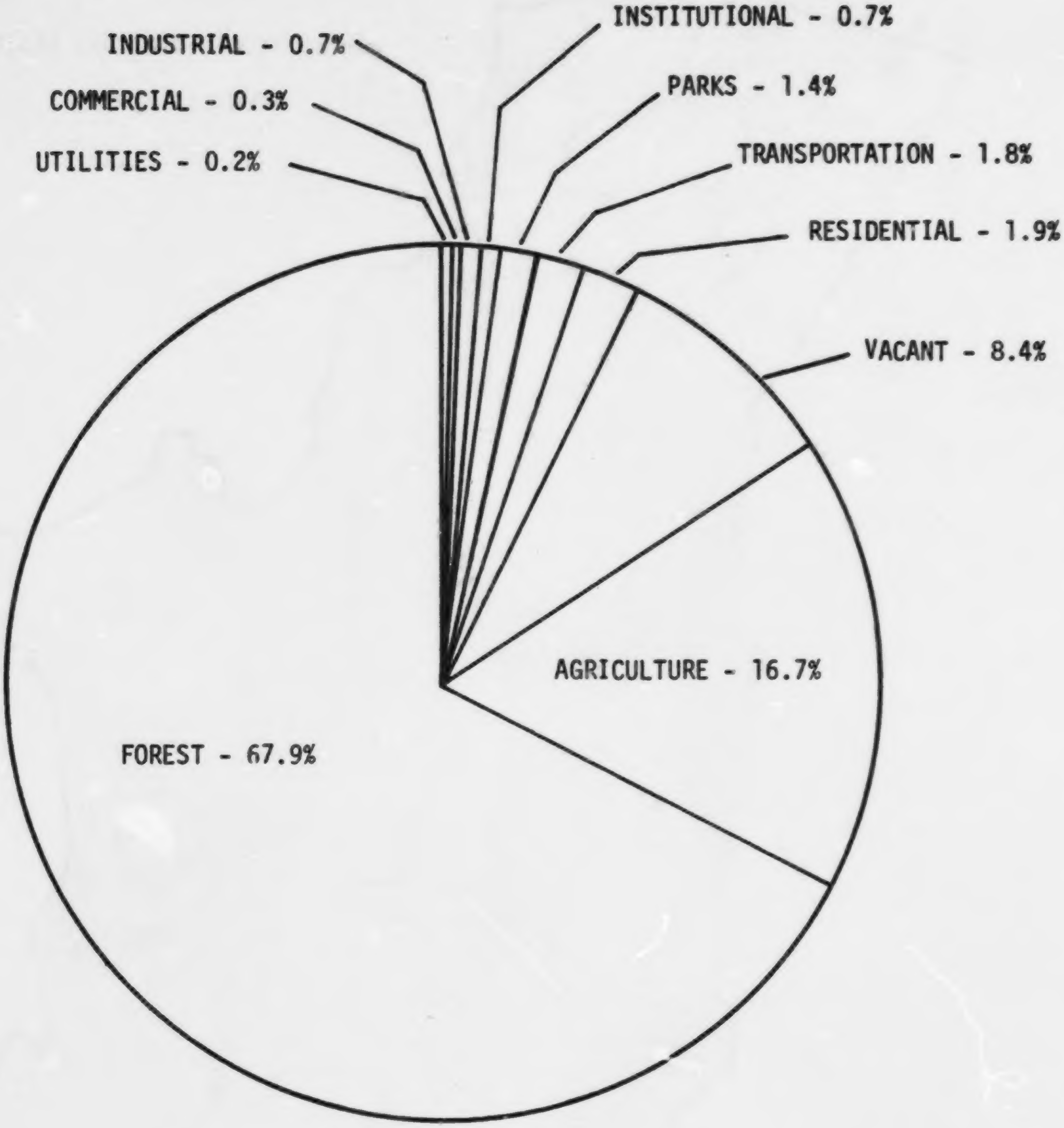
ENVIRONMENTAL SETTING

Geography

As illustrated in Figure II-5, the Study Area includes two major drainage basins, the Utah Lake Basin and the Salt Lake Valley. The Salt Lake Valley is bounded on the east and northeast by the Wasatch Mountains, on the west by the Oquirrh Mountains, and on the south by the Traverse Mountains. The Wasatch Mountains rise abruptly from valley terraces at approximately 5,000 feet to 11,000 feet above sea level. In similar fashion, the Oquirrh Mountains rise approximately 9,000 feet above sea level. The northwestern sector of the Salt Lake Valley is bordered by the Great Salt Lake at 4,200 feet and adjacent lake bottoms. The Traverse Mountains, at 6,500 feet above sea level, form the southern end of the Valley.

The Salt Lake Valley is roughly 31 miles long and has an approximate width of 23 miles. Approximately 68 percent of the 780 square mile drainage area lies within the valley while the remaining 32 percent lies in the surrounding mountains.

From the base of the Wasatch and Oquirrh Mountains, the valley consists of a series of terraces which slope gradually away from the mountains and terminate at an abrupt drop to the next terrace in the series. These terraces were formed by the actions of the ancient Lake



EXISTING LAND USE DISTRIBUTION

FIGURE II-4

FIGURE II-5

JORDAN RIVER-UTAH LAKE BASINS

MOUNTAIN RANGES

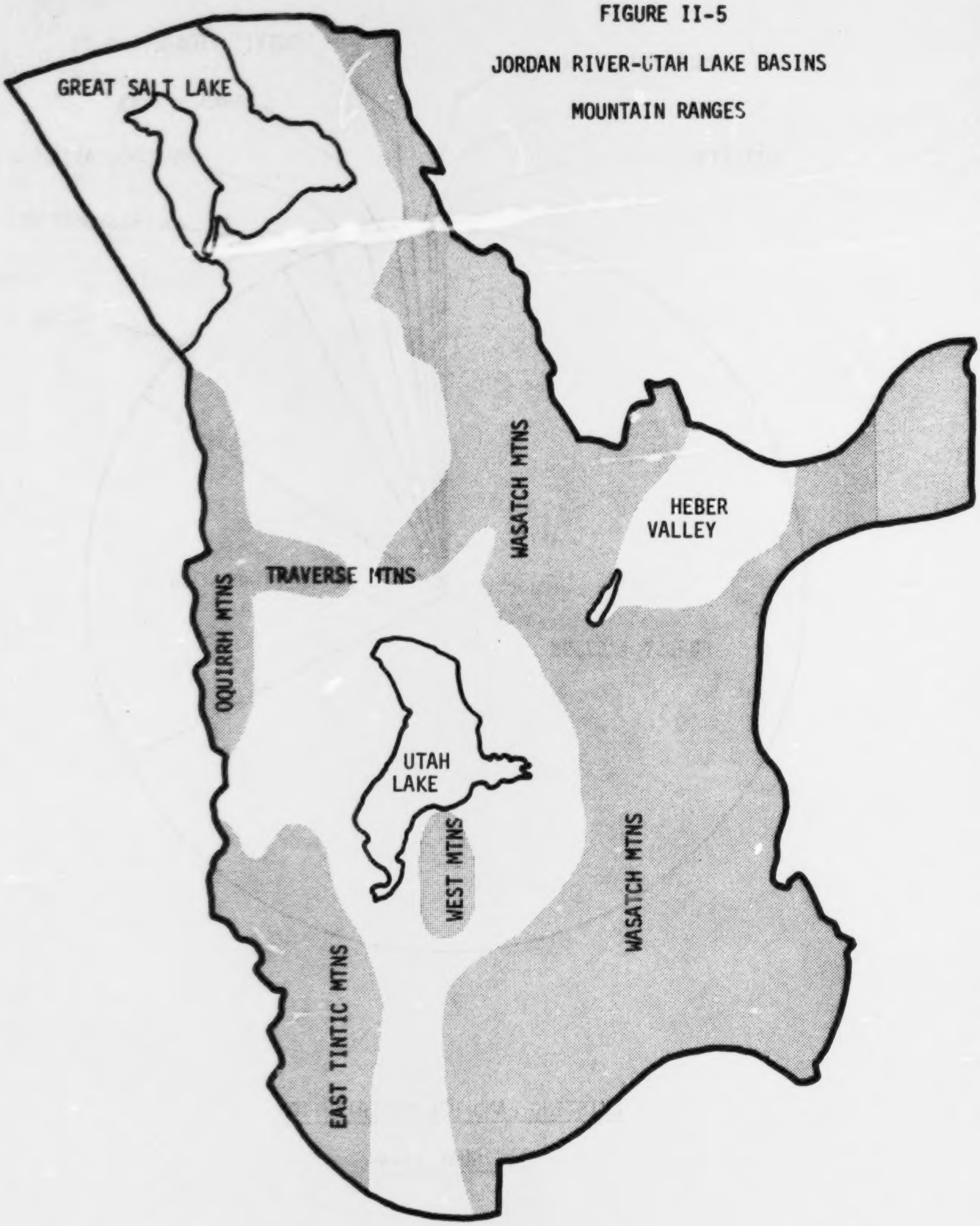

GREAT SALT LAKE
WASATCH MTNS
HEBER VALLEY
TRAVERSE MTNS
OQUIRRH MTNS
UTAH LAKE
WEST MTNS
WASATCH MTNS
EAST TINTIC MTNS

FIGURE II-6
MAJOR HYDROLOGIC FEATURES
OF
UTAH LAKE-JORDAN RIVER BASINS

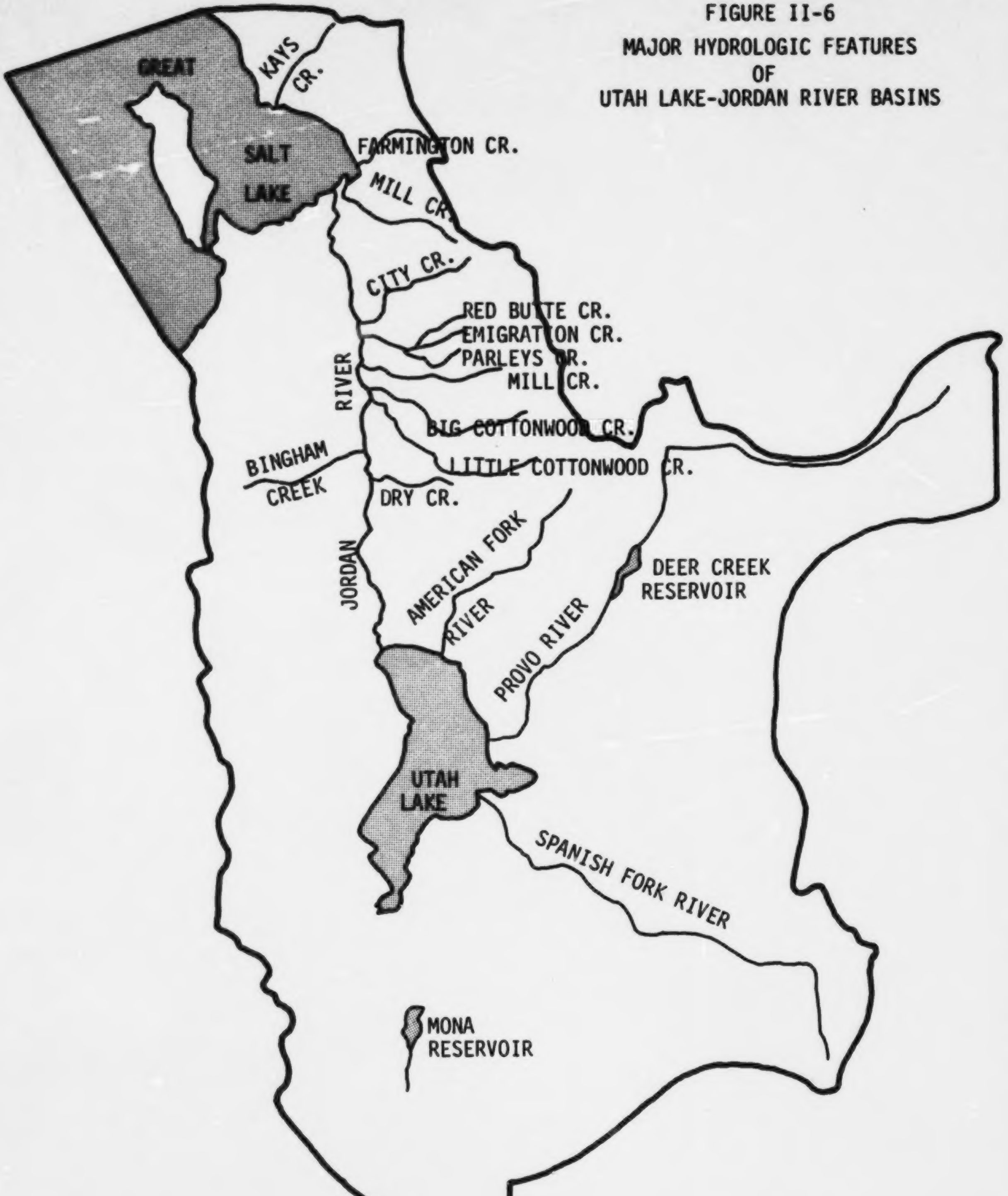

GREAT
SALT
LAKE
KAYS CR.
FARMINGTON CR.
MILL CR.
CITY CR.
RED BUTTE CR.
EMIGRATION CR.
PARLEYS CR.
MILL CR.
BIG COTTONWOOD CR.
LITTLE COTTONWOOD CR.
BINGHAM CREEK
DRY CR.
JORDAN RIVER
AMERICAN FORK RIVER
PROVO RIVER
DEER CREEK RESERVOIR
UTAH LAKE
SPANISH FORK RIVER
MONA RESERVOIR

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FIGURE II-7

GEOLOGIC TIME SCALE

Era	Period	Epoch	Age in Years before Present	Major Geologic Events in United States given in Order of Increasing Age	Distinctive Features of Plant and Animal Life	
CENOZOIC	QUATERNARY	RECENT		Minor changes in landforms by work of streams, waves, wind.	Rise of civilizations.	AGE OF MAN
			10,000			
		PLEISTOCENE		Four stages of spread of continental ice sheets and mountain glaciers.	Development of man. Extinction of large mammals.	
			1,000,000	Cascadian orogeny: Cascade and Sierra Nevada ranges uplifted; volcanoes built;		
	TERTIARY	PLIOCENE			Early evolution of man. Dominance of elephants, horses, and large carnivores.	AGE OF MAMMALS
			13,000,000			
		MIOCENE		Marine sediments deposited on Atlantic and Gulf Coastal Plains. Stream deposits spread over Great Plains and Rocky Mountains basins. Thick marine sediments deposited in Pacific coastal region.	Development of whales, bats, monkeys.	
			25,000,000			
		OLIGOCENE			Rise of anthropoids.	
			36,000,000			
		EOCENE			Development of primitive mammals. Rise of grasses, cereals, fruits.	
			58,000,000			
		PALEOCENE			Earliest horses.	
			63,000,000	Laramide orogeny: Rocky Mountains formed.		
MESOZOIC	CRETACEOUS			Marine-sediment deposition over Atlantic and Gulf Coastal Plains and in geosyncline of Rocky Mountains region.	Extinction of dinosaurs. Development of flowering plants.	AGE OF REPTILES
			135,000,000	Nevadian orogeny: Intrusion of batholith of Sierra Nevada region.		
	JURASSIC			Marine-sediment deposition in seas of western United States. Desert sands deposited in Colorado Plateau.	Culmination of dinosaurs. First birds appear.	
			180,000,000	Palisadian disturbance: Block faulting in eastern United States.		
	TRIASSIC			Deposition of red beds in fault basins of eastern United States and in shallow basins in western United States.	First dinosaurs. First primitive mammals. Spread of cycads and conifers.	
			230,000,000	Appalachian orogeny: Folding of Paleozoic strata of Appalachian geosyncline.		
PALEOZOIC	PERMIAN			Deposition of red shales and limestones in southwestern United States; much salt and gypsum. (Glaciation of Southern Hemisphere continents.)	Conifers abundant. Reptiles developed. Spread of insects and amphibians. Trilobites become extinct.	AGE OF AMPHIBIANS
			280,000,000			
	CARBONIFEROUS PENNSYLVANIAN			Deposition of coal-bearing strata in eastern and central United States.	Widespread forests of coal-forming, spore-bearing plants. First reptiles. Abundant insects.	
			310,000,000			
	MISSISSIPPIAN			Deposition of limy, shaly sediments in widespread shallow seas of central and eastern United States.	Spread of sharks. Culmination of crinoids.	
			345,000,000	Acadian orogeny: Folding and igneous-rock intrusion in New England.		
	DEVONIAN				First amphibians. Many corals. Earliest forests spread over lands.	AGE OF FISHES
			405,000,000	Deposition of thick marine strata in geosynclines of eastern and western United States.		
	SILURIAN				First land plants and air-breathing animals. Development of fishes.	
			425,000,000	Taconian orogeny: Folding of rocks in eastern United States, Nevada, and Utah.		
	ORDOVICIAN				Life only in seas. Spread of mollusks. Culmination of trilobites.	AGE OF MARINE INVERTEBRATES
			500,000,000	Deposition of thick marine strata in geosynclines of eastern and western United States.		
	CAMBRIAN				Trilobites predominant. Many marine invertebrates.	
			600,000,000			
Precambrian time. Age goes back to nearly 3 billion years				Many periods of sediment deposition alternating with orogeny.	Earliest known forms of life. Few fossils known.	

Source: After A. N. Strahler (1960), *Physical Geography*, John Wiley & Sons, New York.

The sediments of the Jordan Valley and Utah Lake Basin were derived from material deposited by Lake Bonneville and possibly from earlier lakes that may have occupied the area. Where streams entered the lake, their velocities were checked, and the coarser sediments were deposited near the lakeshore while finer sediments were carried out into the lake before being deposited. For the most part, sediments brought into the valleys by the mountain streams did not remain undisturbed but were reshaped by the action of waves and shore currents. The product of this activity is the wave-cut terraces or benches and the bars and spits that are a conspicuous feature of the present topography.

The Jordan River was formed 11,000 to 12,000 years ago when the main body of Lake Bonneville, on the Salt Lake Valley side, started to drop. The remaining part of the Lake on the Utah Valley side was sustained by the Provo River. It eventually overflowed a naturally formed barrier between the two valleys during higher lake stages thus forming the Jordan Narrows.

The Heber Valley is on the transitional zone between the Wasatch and Uintah Mountain Ranges. A portion of the Valley is underlain by Tertiary volcanic rocks giving rise to the predominance of high water tables in the area.

Faulting is present within the Study Area and is of concern in terms of location of interceptors, treatment plants, etc. As shown in Figure II-8, seismic activity occurs along the boundary between the Basin and Range province and the Colorado Plateau-Middle Rocky Mountain provinces. This is part of the belt of seismic activity that extends from the Gulf of California north into British Columbia.

The Wasatch fault zone is one of the major zones of crustal displacement in the Study Area and is still active. The fault line parallels the west base of the Wasatch Mountain range and has a westward dip. This can cause a displacement of an earthquake epicenter to the west. Such a situation can cause major damage westward throughout the Salt Lake and Utah Lake Valleys.

Faulting is also present within the Heber Valley and is the result of uplift and forces related to intrusion of the large igneous stocks. Fault zones known and mapped by mining companies cross the valley from the Mayflower mine on the west to the vicinity of the Park Premier shaft on the east of the valley.

Soils

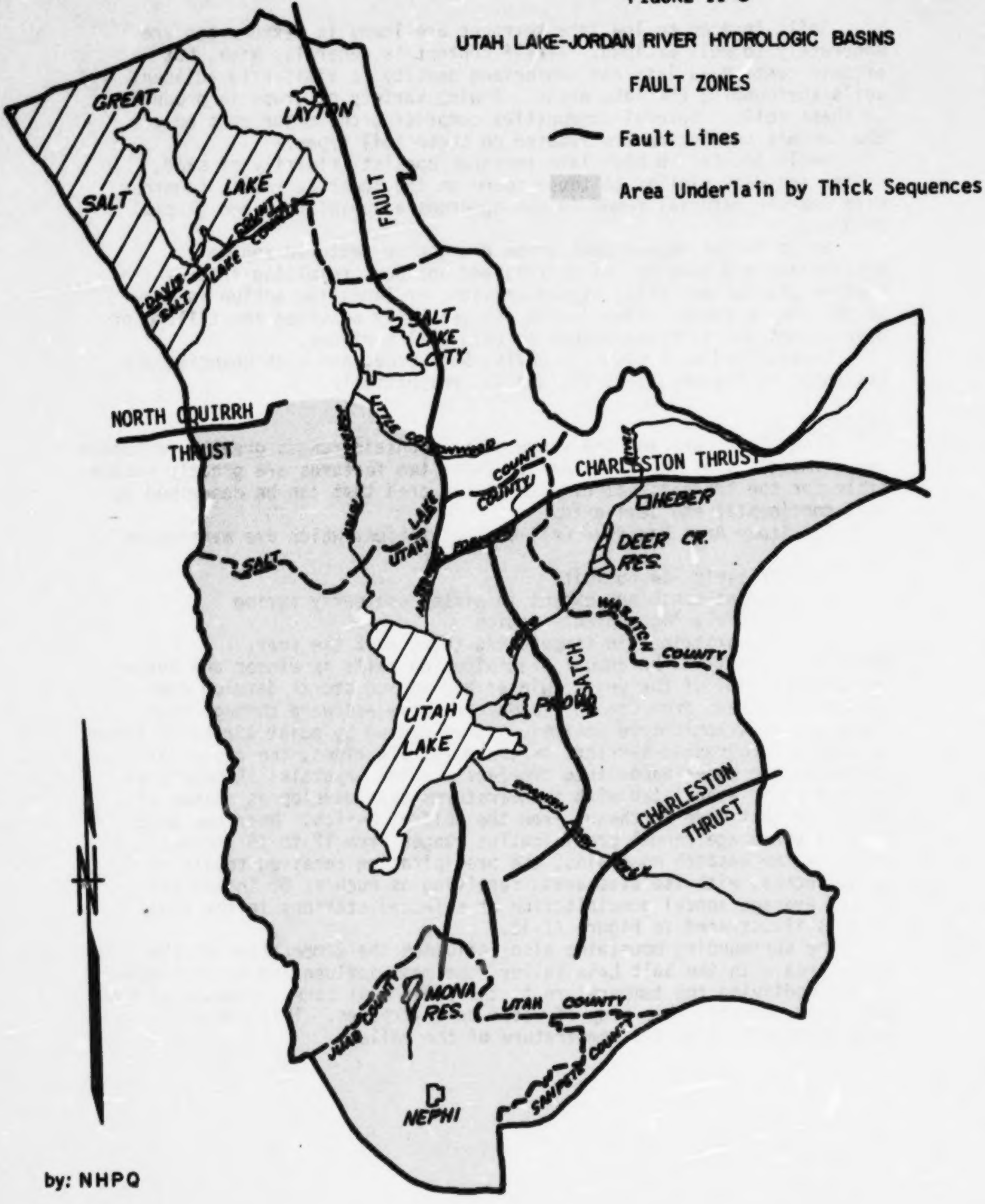
The soils within the two hydrologic basins have characteristics that were influenced both by glaciers and by ancient Lake Bonneville. Four basic soil types are found within the area.

The soils surrounding and underlying the Great Salt Lake, Jordan River, and portions of Utah Lake are heavy-clay textured, poorly drained, high in organic content, low in density and are commonly high in alkali content. The water table is usually very high in these areas. The soils are generally unsuited for agriculture or urban development without special treatment.

FIGURE II-8

UTAH LAKE-JORDAN RIVER HYDROLOGIC BASINS

FAULT ZONES


Fault Lines
Area Underlain by Thick Sequences
GREAT SALT LAKE
LAYTON
FAULT
DAVIS COUNTY
SALT LAKE COUNTY
SALT LAKE CITY
NORTH OQUIRRH THRUST
LITTLE COTTONWOOD
SALT LAKE COUNTY
UTAH COUNTY
CHARLESTON THRUST
HEBER
DEER CR. RES.
WASATCH COUNTY
WASATCH
UTAH LAKE
PROVO
CHARLESTON THRUST
MONA RES.
UTAH COUNTY
JUAB COUNTY
SANPETE COUNTY
NEPHI
N

by: NHPQ

Soils located on low lake terraces are loamy in texture and are moderately to well drained. Alkali content is generally high, but organic content is less and subsurface density is similar to adjacent soils surrounding the lake areas. A wide variety of crops is produced on these soils. Several communities comprising the major portion of the basin's population are located on these soil types.

Soils located on high lake terraces consist primarily of sand, silts, and clay similar to those found on the lower terraces, together with coarser material found in the numerous alluvial fans and glacial moraines.

Soils in the mountainous areas are coarse textured and well drained and are composed of gravels and boulders resulting from extensive glacial activity, stream erosion, or landslide action in many of the canyon areas. These soils are generally unsuited for tillage or development due to steep slopes or thin soil horizons.

Generalized soil maps for Davis, Salt Lake, and Utah Counties are presented in Figures II-9, 10, and 11, respectively.

Climate

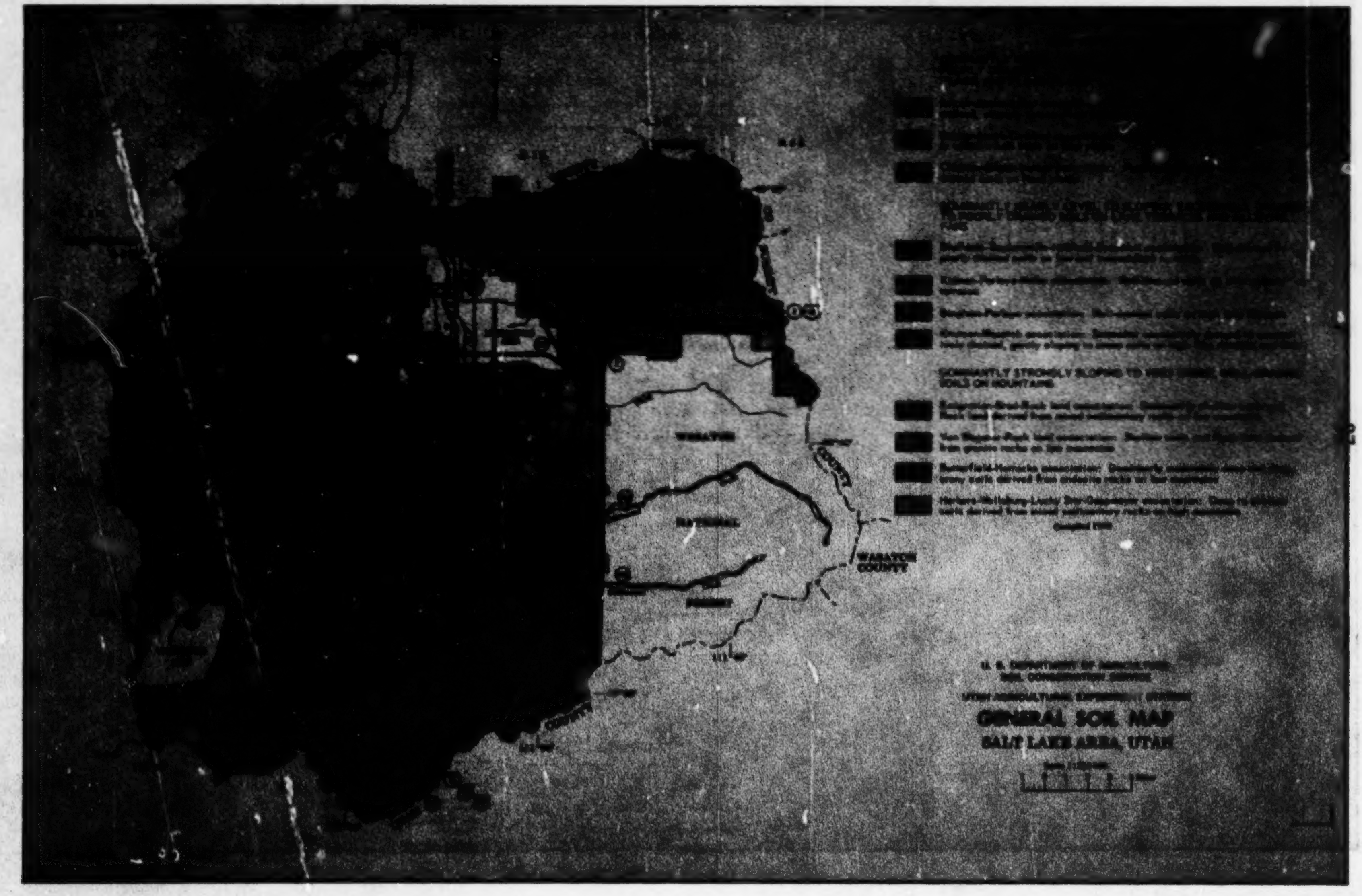
Great Salt Lake and the surrounding mountain ranges greatly influence the climatology of the Study Area. These two features are greatly responsible for the transitional climate of the area that can be described as semi-continental and semi-arid.

The Study Area has four well-defined seasons which are manifested by:

- relatively low humidity
- abundant sunshine, except in winter and early spring
- relatively light precipitation
- wide variations in temperature throughout the year.

About 60 percent of the annual precipitation falls in winter and spring, the wettest part of the year. Winter and spring storms develop over the Pacific Ocean from October to May and move eastward through Utah. These are orographic type storms: storms caused by moist air being forced up over a topographic barrier, as the moist air rises, the cooler air condenses the water vapor into droplets and ice crystals. Summer precipitation is associated with thunderstorms that develop as masses of moist air that move northward from the Gulf of Mexico. Near the Great Salt Lake average annual precipitation ranges from 12 to 15 inches, while in the Wasatch Mountains, the precipitation received totals 35 to 40 inches, with isolated areas receiving as much as 60 inches per year. Average annual precipitation at selected stations in the Study Area is illustrated in Figure II-12.

The surrounding mountains also influence the temperature of the Study Area. In the Salt Lake Valley, the most influencing natural condition modifying the temperature is the Great Salt Lake. Because of its high salt content, this body of water never freezes. This has a moderating effect on the temperature of the valley.


WASATCH COUNTY
DOMINANTLY STRONGLY SLOPING TO
SOILS ON MOUNTAINS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UTAH AGRICULTURAL EXPERIMENT STATION
GENERAL SOIL MAP
SALT LAKE AREA, UTAH

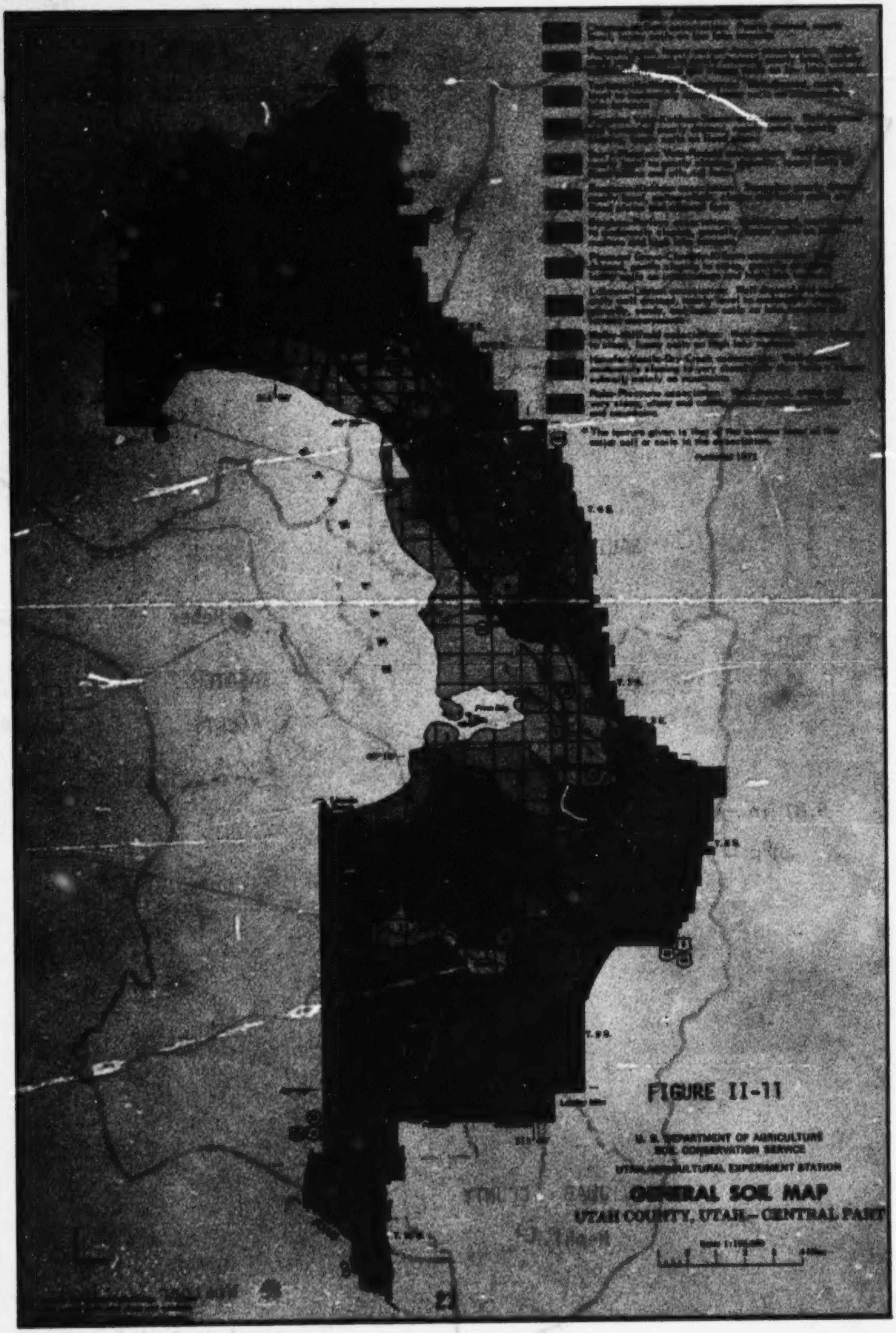
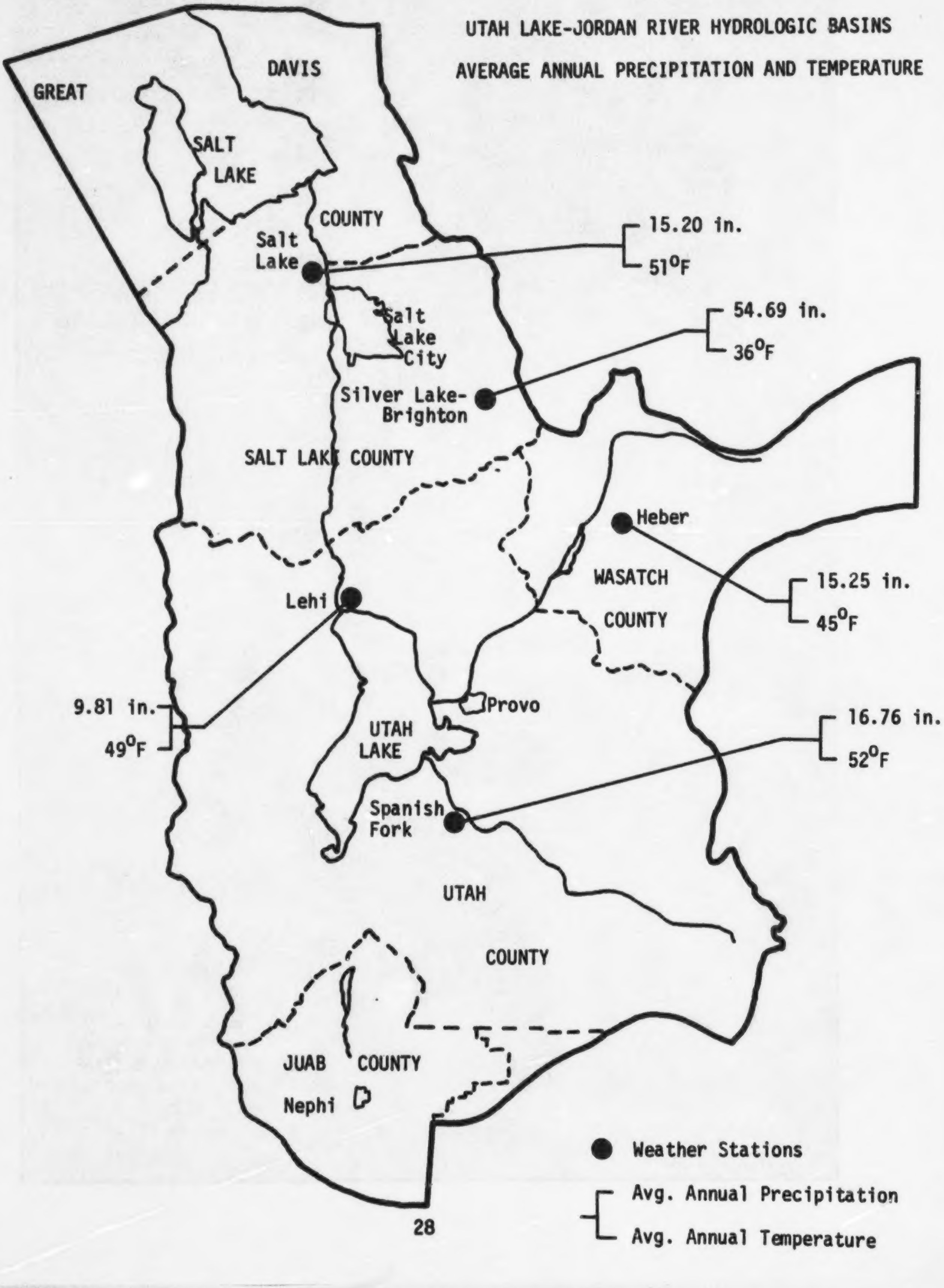

T. 6 S.
T. 7 S.
T. 8 S.
T. 9 S.
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UTAH AGRICULTURAL EXPERIMENT STATION
GENERAL SOIL MAP
UTAH COUNTY, UTAH—CENTRAL PART

FIGURE II-11

FIGURE II-12

UTAH LAKE-JORDAN RIVER HYDROLOGIC BASINS

AVERAGE ANNUAL PRECIPITATION AND TEMPERATURE


GREAT
SALT
LAKE
DAVIS
COUNTY
Salt Lake
15.20 in.
51°F
Salt Lake City
Silver Lake-Brighton
54.69 in.
36°F
SALT LAKE COUNTY
Heber
WASATCH
COUNTY
15.25 in.
45°F
Lehi
9.81 in.
49°F
Provo
UTAH LAKE
Spanish Fork
16.76 in.
52°F
UTAH
COUNTY
JUAB
COUNTY
Nephi
● Weather Stations
Avg. Annual Precipitation
Avg. Annual Temperature

Due to the surrounding mountains, there is a tendency for cold air to pool at the bottom of valleys and to form strong inversions during the colder parts of the year. The intensity of these inversions is demonstrated by the variations in growing seasons near Utah Lake and those on the higher terraces. At Provo, near the Lake, the growing season is only 126 days. At Utah Lake-Lehi, at the northern end of the Lake, the average frost-free period is 132 days and is 167 days at Spanish Fork.

Notwithstanding the cold air pools, temperatures vary with changes in elevation, dropping as elevations increase. The average daily temperature varies most from June to October and least from December to February. As illustrated in Figure II-12, average annual temperatures range from about 51°F. near the Great Salt Lake to about 36°F. in the Wasatch Mountains.

Wind in the Study Area is highly variable depending upon location. Normal wind patterns are determined by topography. Essentially they are upslope during the warm part of the 24-hour period, and downslope during the cool part. These winds can be overridden by strong winds associated with frontal systems which may blow for 24 to 36 hours from the south before a storm. Following a storm, the winds shift to the north and occasionally blow at more than 90 miles per hour. Extremely strong winds occur occasionally during the middle of the summer with local thunderstorms.

Generally, the climate of the area is variable but is not extreme. The mountain ranges act as barriers normally preventing the movement of Arctic air masses from entering the valley.

Terrestrial and Aquatic Ecosystems

A generalized ecosystem unit classification system for the Study Area is presented in Table II-2. The approximate geographic boundaries of each unit are illustrated in Figure II-13. An inventory of the flora and fauna of the Study Area is presented in Volume C-1000, "Definition of the Existing Data Base for the Natural Environmental Setting," of the Study Task Report Series.

The Great Salt Lake Desert ecosystem is limited to the area surrounding the Great Salt Lake in the Study Area. Major biotic communities include marsh, juniper, mixed brush, greasewood, shadscale, and vegetated dune.

The desert habitat types are dominated by small mammals and birds. Typical of the desert communities are the black-tailed jack rabbit, several species of ground squirrels, and the kangaroo rat. Only the red-shouldered hawk and the burrowing owl are confined to the Salt Desert.

While the climate of this area can be described as desert, much of the land is marshland. This marshland is a strip of land about seventy miles long and two to eighteen miles wide on the southeastern shore of the Great Salt Lake. Much of the marshland has been developed by diking and impounding waters that formerly drained into Great Salt Lake. Development has been by private, state, and federal agencies.

TABLE II-2

SELECTED ECOSYSTEM UNITS FOR JORDAN RIVER-UTAH LAKE BASINS

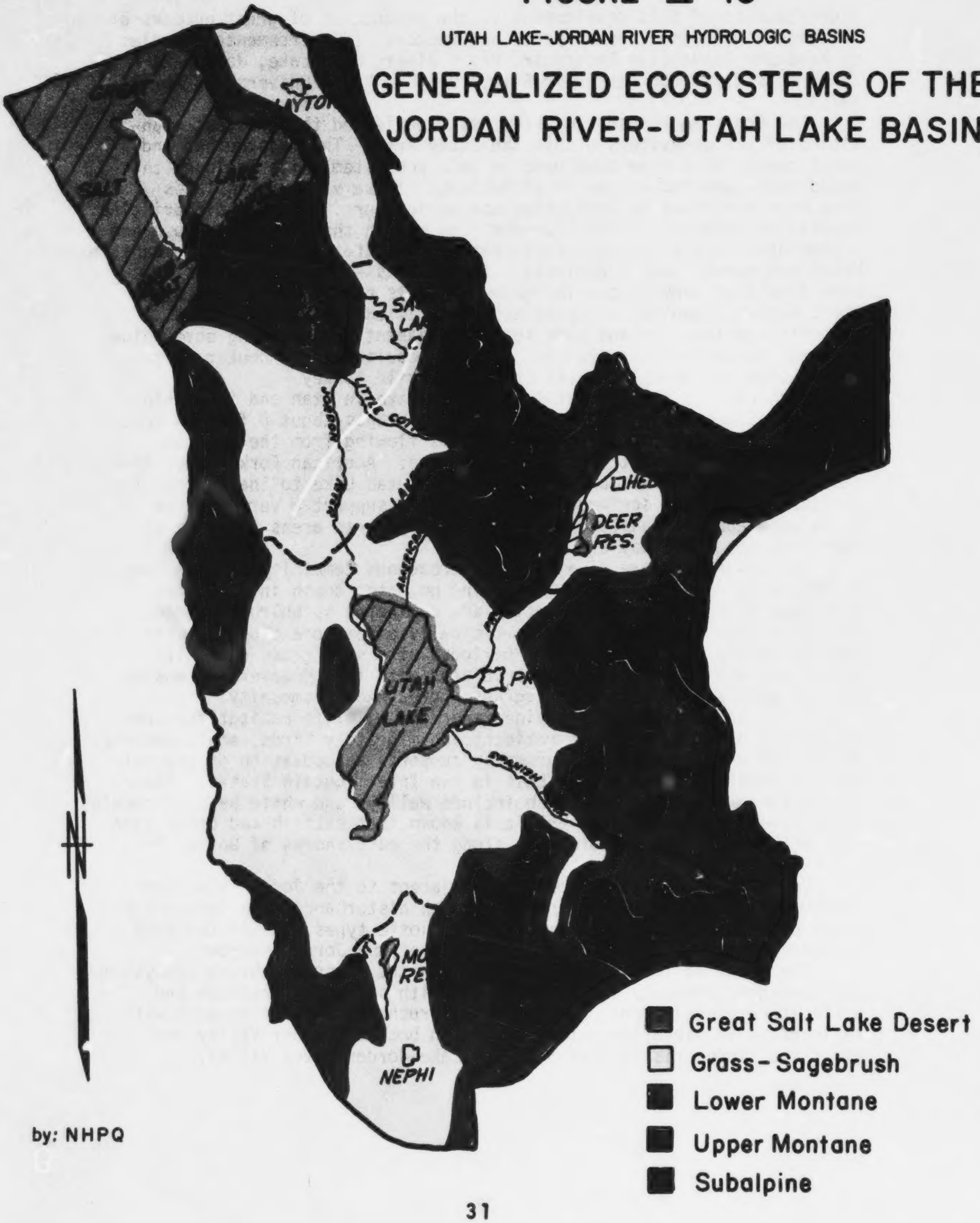
Ecosystems	*Altitudinal Limits	Average Annual Precipitation	Frost Free Period
Great Salt Lake Desert	4200 to 4300	11 to 16	130 to 190
Grass-Sagebrush	4300 to 6000	14 to 18	160
Lower Montane	6000 to 7500	18 to 25	95
Upper Montane	7500 to 9000	25 to 35	65
Subalpine	900 to 11,000	35	65

*Ecosystem boundaries are not sharp; consequently these figures are only approximations.

FIGURE II-13

UTAH LAKE-JORDAN RIVER HYDROLOGIC BASINS

GENERALIZED ECOSYSTEMS OF THE JORDAN RIVER-UTAH LAKE BASINS


GREAT
SALT
LAKE
LAYTO
SA
LAK
C
LITTLE COTT
JORDAN
RIVER
AMERICAN
HEB
DEER RES.
UTAH LAKE
PR
SPANISH
MO
RE
NEPHI
N
■ Great Salt Lake Desert
□ Grass-Sagebrush
■ Lower Montane
■ Upper Montane
■ Subalpine

by: NHPQ

A consequence of this development is the production of great numbers of mosquitoes and other insect pests and vestors ("Environmental Studies of Proposed Jordanelle Reservoir, Provo River, Utah Lake, Jordan River, and Proposed Lampton Reservoir Site," Brigham Young University, April 1975).

The Grass-Sagebrush ecosystem has experienced the greatest transition of the ecosystems within the Study Area. The major urban and rural communities have developed in this ecosystem which includes the broad Utah Lake and Jordan River Valleys. These valley grasslands have been converted to irrigation and agriculture. Very little pristine vegetation remains. Various communities within the Grass-Sagebrush ecosystem are: the grass-sagebrush, wet meadow-stream side willow, mountain brush and marsh. Man's activities in the Grass-Sagebrush ecosystem have displaced many of the indigneous animals of the area. The niche these native organisms occupied has been filled by introduced and domestic species. Upland game such as pheasant and mourning dove abide in large number and compete with smaller populations of chukar partridge, sage and forest grouse, quail, and wild turkey.

Utah Lake is the largest fresh water lake in Utah and is within the Grass-Sagebrush ecosystem. The Lake averages about 8 feet in depth and receives water from tributary streams flowing from the Wasatch Mountains. Principal tributary streams are: American Fork, Provo River, and Spanish Fork. The Jordan River drains Utah Lake to the north. The various aquatic and semi-aquatic communities support a very diverse flora and fauna. Utah Lake has two wildlife marsh areas that are of significance, Provo Bay and Goshen Bay.

The dominant shore line aquatic herbaceous community of Utah Lake is either bulrush or cattail, depending on water depth in Utah Lake. Semi-aquatic herbaceous communities are dominated by bulrush, sedge, and spikerush. These communities typically experience flooding with shallow waters and alternate dry periods. The salt grass community may or may not have greasewood associated with it. However, in Goshen Bay there is a well defined saltgrass - greasewood community.

These communities all provide important wildlife habitat for some 20 species of fish, numerous resident and migratory birds, small mammals, and upland game. Utah Lake currently supports a population of channel catfish considered one of the best in the Intermountain States. Other significant warm water game fish include walleye and white bass. Spawning areas have not been defined but it is known that catfish and other game fish utilize the rocky shore area along the east shores of Goshen Bay and Provo Bay.

The various habitat communities adjacent to the Jordan River are predominantly agricultural lands. Through disturbance, the indigenous plant communities have been replaced by exotic types. A limited area of Grass-Sagebrush exists in the vicinity of the Jordan Narrows.

The Heber Valley is completely within the Grass-Sagebrush ecosystem. The dominant community is the sagebrush with stands of oakbrush and agricultural development. Stands of oakbrush increase in density with an increase in elevation. This occurs in both the Heber Valley and along the slopes rising from the Utah Lake-Jordan River Valley.

The Lower Montane ecosystem is characterized by a climax community of Ponderosa pine (yellow pine) - Douglas Fir - White Fir. Intermixed throughout this community are subclimax stands of quaking aspen and lodgepole pine.

Englemann Spruce - Subalpine Fir form the dominant vegetation associations in the Upper Montane ecosystem. This spruce-fir association is limited to the higher elevations and covers only small portions of the Study Area.

The Lower and Upper Montane ecosystems provide diverse habitats of cover and living space, and food and water requirements for an abundant and varied wildlife. Animals are likely to migrate between the Lower and Upper Montane. Therefore, an inventory of organisms produces a list of species that could be considered common to both. Animals shy to encroachment into their habitat may tend to exist at the high elevations. Dominant species include Rocky Mountain Mule Deer, yellow-haired porcupine, and snowshoe rabbit. Small mammals are dominated by various species of squirrels, chipmunks, and shrews. Skunk, pika, and various rodents are also associated with this ecosystem. The more common smaller birds include woodpeckers and flycatchers, the rock wren, Western robin, mountain bluebird, and the gray-headed Junco.

The Subalpine regions of the Study Area are extremely limited. They can be characterized as having a very rugged terrain due to soils, topography, heavy snow accumulations and historic glacial action. Wet meadows may be common. The Englemann Spruce-Subalpine Fir Association occurs in this ecosystem as well as large areas of exposed rock. Plant and animal life is restricted due to the harsh environment and lack of habitat area.

Hydrology

Surface Waters

There are approximately 480 miles of surface streams and 62 lakes and reservoirs in the Study Area. Surface water systems consist of Utah Lake and its tributaries, Jordan River and tributaries, and Great Salt Lake and its tributaries, including the Jordan River.

Utah Lake is a shallow, freshwater lake 25 miles long and 11 miles wide with a surface area of approximately 150 square miles. Historical mean depths of 20 feet have been recorded, however, increased diversions of tributary flows and siltation have reduced the mean depth to approximately eight feet. The capacity of Utah Lake has been estimated to be 883,900 acre-feet and the principal water uses are irrigation and recreation.

Utah Lake is fed by two large rivers, the Provo River and Spanish Fork, and several smaller streams. The location of these feeder streams is shown in Figure II-14. The natural inflow to the Lake is approximately 500,000 acre-feet per year, half of which occurs during April, May, and June.

Currently four large interbasin transfers deliver an average of almost 150,000 acre-feet to the Utah Valley's supply, while a fifth extracts approximately 25,000 acre-feet annually. The Ontario Tunnel

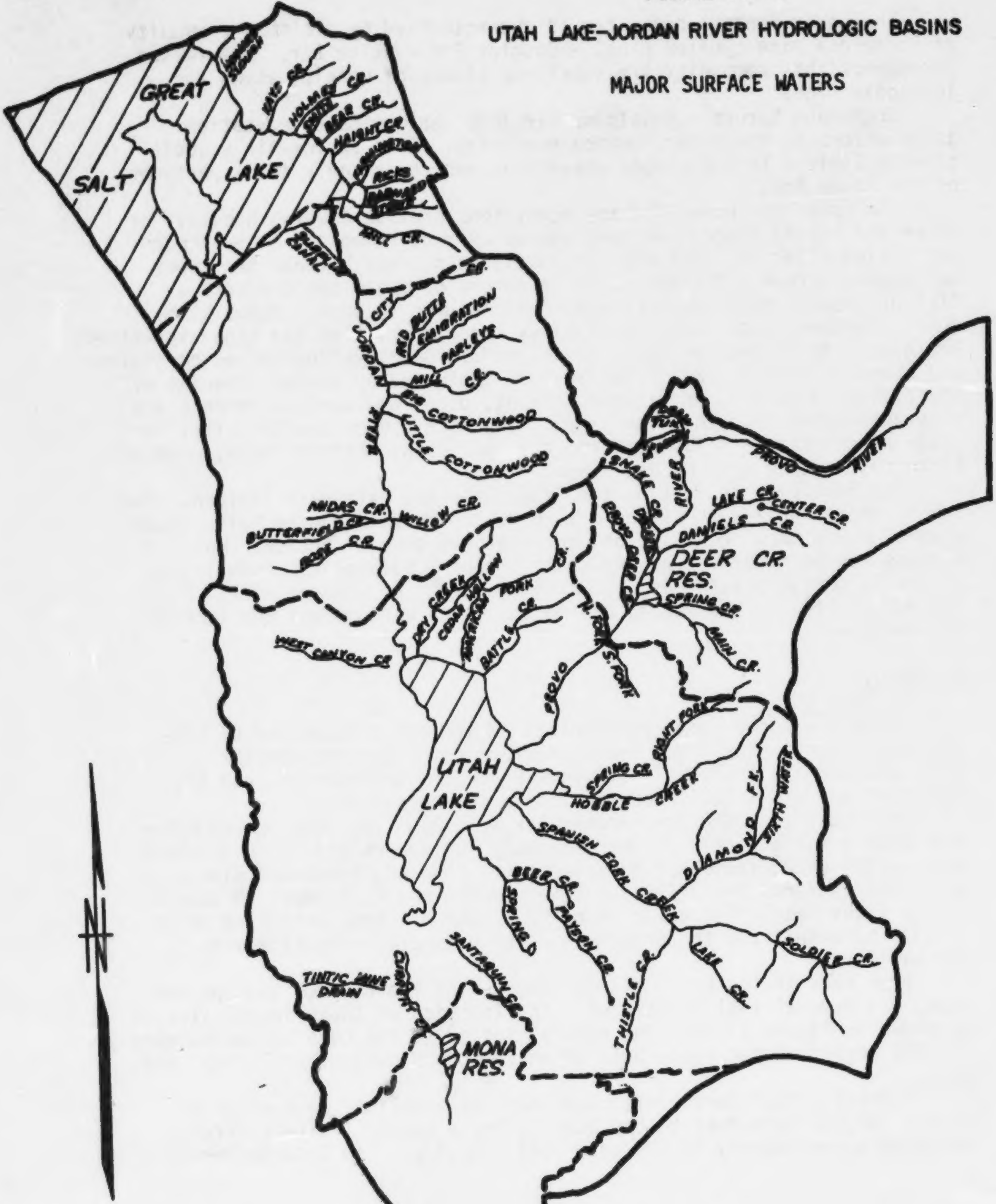

GREAT
SALT
LAKE
KAYS CR.
HOLMES CR.
BEAR CR.
HAIGHT CR.
FARMINGTON
RICKS
MILL CR.
SURPLUS CANAL
CITY CR.
RED BUTTE
EMIGRATION
PARLEYS
MILL CR.
BIG COTTONWOOD
LITTLE COTTONWOOD
JORDAN
RIVER
MIDAS CR.
BUTTERFIELD CR.
ROSE CR.
WILLOW CR.
WEST CANYON CR.
DRY CREEK
CEDAR HOLLOW
AMERICAN FORK
BATTLE CR.
CR.
N. FORK
S. FORK
PROVO
SNAKE CR.
RIVER
PROVO RIVER
PROVO DEER CR.
LAKE CR.
CENTER CR.
DANIELS CR.
DEER CR.
RES.
SPRING CR.
MAIN CR.
RIGHT FORK
SPRING CR.
HOBBLE CREEK
UTAH
LAKE
DIAMOND F.K.
SIXTH WATER
SPANISH FORK CREEK
BEER CR.
SPRING
PAYSON CR.
SANTAQUIN CR.
TINTIC MINE DRAIN
CURRANT CR.
MONA
RES.
THISTLE CR.
LAKE CR.
SOLDIER CR.
N

FIGURE II-14

UTAH LAKE-JORDAN RIVER HYDROLOGIC BASINS

MAJOR SURFACE WATERS

by: NHPQ

diverts approximately 10,000 acre-feet/year of Silver Creek water to the upper reaches of the Provo River. This is supplemented by approximately 30,000 acre-feet/year from the Duchesne River and 50,000 acre-feet/year from the Weber-Provo Canal. Approximately 70,000 acre-feet/year are diverted from Strawberry Reservoir to Diamond Fork, a tributary of Spanish Fork.

Approximately half of the water that enters Utah Valley is supplied via the Provo River. The headwaters of the Provo River are located in the western part of the Uinta Mountains about 45 miles northeast of Provo. The River flows westward from the high mountain streams and lakes through the Kamas Valley and south into the lower Heber Valley where it is dammed, forming Deer Creek Reservoir, with a capacity of 152,570 acre-feet. Below the dam, the river flows southwestward, crossing the Wasatch Mountains through Provo Canyon to enter Utah Lake west of the City of Provo. The mean annual discharge of the Provo River is estimated to be 350,500 acre-feet/year (484 cfs).

The Spanish Fork Basin, the second largest source of water entering Utah Lake, lies southeast of Utah Valley. The Spanish Fork rises on the Wasatch Plateau, west of Soldier Summit, about thirty miles southeast of the City of Spanish Fork, and flows northwest to its confluence with Thistle Creek at Thistle. Continuing northwestward, the river traverses the Wasatch Range through Spanish Fork Canyon, entering Utah Lake four miles northwest of the City of Spanish Fork. The mean annual discharge of the Spanish Fork is 157,800 acre-feet/year (218 cfs).

Approximately half of the total annual inflow to Utah Lake is lost to evaporation. Flow from the Lake into the Jordan River is regulated all year. During low lake stages, water is pumped from the Lake into the River.

From Utah Lake, the Jordan River meanders approximately 55 river miles northward to the Great Salt Lake. The river gradient is slight, averaging only 5.2 feet per mile, and flows are consequently slow moving. River flows are supplemented by many tributaries entering the river from the east and are depleted during the summer by diversions into irrigation canals. Major tributaries are illustrated in Figure III-14. Throughout most of its length, the river gains from groundwaters entering from springs and seeps and from agricultural irrigation return flows.

At the Jordan Narrows, where the Jordan River cuts through the Traverse Mountains 10 miles north of Utah Lake, the bulk of the river flow is diverted into irrigation canals. Flow immediately below the diversion varies from 1,400 cfs during the spring runoff to zero during the growing season. North of the diversion, the river meanders through a broad flood plain, gaining flow from the groundwater, irrigation return flows, several minor wastewater treatment plants, Corner Canyon Creek and Dry Creek. Southwest of Murray, the river passes through several areas of marshland.

North of Bennion the flood plain broadens and the course of the river becomes even more tortuous. The ten-mile reach of the river north of Bennion to the Salt Lake City Airport passes through the Salt Lake City metropolitan area and is the recipient of many municipal and industrial waste discharges. At 21st Street South, the bulk of the river flow is again diverted, this time into the Surplus Canal. The purpose of the Surplus Canal is to provide a short, direct route to the Great Salt Lake for Jordan River flows in excess of those that can pass down the natural river channel without flooding. North of Salt Lake City, the river flows through wide expanses of salt marsh to reach the Great Salt Lake approximately seven miles northwest of the city limit.

The Great Salt Lake, a remnant of ancient Lake Bonneville, is the final repository for the waters of the Utah Lake and Jordan River Basins. The lake is a large, shallow and highly saline, closed water body which gains water mainly from streamflow from the mountains to the east and loses water by evaporation. It is the largest lake in the Western Hemisphere that does not drain to the ocean. In 1965, at a lake surface elevation of 4,194 feet, the surface area was about 1,000 square miles and the maximum measured depth was 27 feet.

The Great Salt Lake changes volume continuously in response to the difference between the volume of inflow and evaporation losses. The total load of salt in the lake is relatively constant; however, salt concentration obviously changes with changes in lake volume. Salt content during the last 50 years has generally remained within the range of 250 to 350 grams/litre.

The impact on surface water hydrology from several proposed state and other federal projects is discussed in Chapter VII.

Groundwater

Approximately 126,000 acre-feet of the groundwater supply are presently being utilized annually in the Salt Lake County-Jordan River Valley area. Of the total, 117,000 acre-feet are withdrawn from the confined aquifer. The remaining 9,000 acre-feet come from natural discharge from the shallow aquifer. About 55 percent of the 212,000 acre-feet annual recharge to the confined system is presently being withdrawn and used from wells and springs. The remaining 45 percent is being discharged naturally to Great Salt Lake and to the shallow water table by upward leakage. Some of the discharge to the shallow water table finds its way into the Jordan River. The remainder is consumed by phreatophytes and lost through evapotranspiration.

In Utah County, about 73,000 acre-feet of groundwater are withdrawn by wells each year. Of this amount, 40,500 acre-feet/year are withdrawn from wells in northern Utah County, 21,000 acre-feet/year in southern Utah County, and 11,500 acre-feet/year from Goshen Valley. Only 500 acre-feet of the total are withdrawn from the unconfined aquifer. An additional 55,000 acre-feet are discharged to Utah Lake by springs within the Lake, by upward leakage into the Lake, and by some springs located at the edge of the Lake. Well discharge accounts for slightly over half of the recharge to the confined aquifer systems. Recharge and discharge are in equilibrium in north and south Utah Valleys but discharge exceeds recharge by about 7,600 acre-feet in the Goshen Valley.

In the Heber Valley area, groundwater is discharged from the unconsolidated deposits by pumping from wells, evapotranspiration, effluent seepage, and probably by subsurface outflow through the surrounding consolidated rocks. The total volume of water pumped from wells is very small, and because no drastic changes in irrigation practice have occurred, the long-term recharge-discharge regimen remains fairly stable.

In some sectors of the Study Area, additional groundwater could be developed. The volumes of present and additional development estimated for each area are summarized in Table II-3. Generally, in areas where additional development is assumed to be possible, recharge is in equilibrium with discharge. This means that well development would increase at the expense of natural discharge.

Water Quality

Information on existing water quality and water quality problem areas is couched in terms of specific parameter levels. To aid the reader in understanding the character of water quality in the Study Area, the presentation is prefaced by a discussion of the specific parameters.

Dissolved Oxygen

The concentration of Dissolved Oxygen (DO) can be considered one of the most significant elements in an aquatic ecosystem. The composition and productivity of the more desirable biological communities is a function of dissolved oxygen concentration. Simply, as DO levels decrease, more pollutant tolerant species predominate. As DO increases, the most desirable aquatic life forms, such as trout, dominate.

In the Study Area, all surface waters except Utah Lake and the Jordan River from Utah Lake to the Jordan Narrows are classified "CC," cold water fisheries. Utah Lake and the upstream segment of the Jordan River are classified "CW," warm water fisheries. Class CC requires a minimum DO concentration of 6.0 mg/l and Class CW requires at least 5.5 mg/l of DO.

Biochemical Oxygen Demand

The Biochemical Oxygen Demand (BOD) determination is used to assess the content of bacterially degradable organic material in an ecosystem. In general, the higher the BOD the greater the potential for pollution and oxygen depletion. High BOD values can also be linked to the health hazards of polluted waters. For these reasons, the State of Utah has established a maximum BOD concentration of 5.0 mg/l for all Class C waters in the State.

Total Coliforms

The coliform group of bacteria is found in human and animal excrement as well as on plants and in the soil. Although they are not considered to be disease-causing organisms, their presence in water in large numbers is considered to be an indicator of pollution and a public health hazard. The State of Utah Class C standard limits the concentration of total coliform bacteria to 5,000 per 100 ml.

TABLE II-3

SUMMARY OF GROUNDWATER POTENTIAL

Area	Estimated Recharge (ac-ft/year[1])	Present Well Discharge (ac-ft/year)	Surplus or Deficit (ac-ft/year)	Estimated Potential Increase (ac-ft/year)
Salt Lake County	212,000	126,000[2]	86,000	50,000[3]
Utah County	138,000	72,500	65,500	15,000
Northern Juab County	Undetermined	15,000	Undetermined	None
Wasatch County-Heber Valley	86,000	Undetermined	Undetermined	Undetermined

[1] Recharge to principal aquifer system.

[2] Includes 19,000 acre-feet diverted from springs.

[3] Consists of 30,000 acre-feet quality water and 20,000 acre-feet low quality water.

Nutrients

A variety of nutrients are required to sustain a viable aquatic ecosystem. The relative abundance of various nutrients determines the character and productivity of the ecosystem. When one or more nutrients are introduced in abnormal amounts, usually because of man's intervention, system productivity may become unbalanced, leading to the proliferation of undesirable species.

Nitrogen and phosphorus often appear to be the limiting nutrients in an aquatic ecosystem and when present in excess, lead to uninhibited algal growth resulting in reduced light transmittance, aesthetic problems, and eventual decomposition and oxygen depletion.

The State of Utah has not defined specific standards for either nitrogen or phosphorus forms. However, the Water Quality Management Plan established nitrate levels in excess of 0.5 mg/l and phosphate levels in excess of 0.05 mg/l as nutrient enrichment problems.

Total nitrogen (TN) represents the sum of all nitrogen forms. Under normal conditions nitrogen is converted from one form to another but is rarely lost from an ecosystem, thus the TN value usually remains constant or increases with inputs.

Total Dissolved Solids

Total Dissolved Solids (TDS) are the non-filterable materials contained in water. As such, TDS content can be related to salinity or salt content of water. High TDS values can render a watercourse unuseable for agricultural use, aquatic habitat, or human consumption.

The State of Utah Class C water quality standard does not directly address TDS concentration. However, the standard does require that:

> "Chemical .... standards shall be as prescribed for drinking water by 'Public Health Service Drinking Water Standards, 1962'."

These standards require a maximum TDS concentration of 500 mg/l.

Existing Water Quality

Water quality problems in the Study Area, within the context of the parameters discussed above, are illustrated in Figures II-15 through II-26. The reference symbols, < and > , refer to "less than" and "greater than," respectively.

Further detailed discussion of existing water quality problems in the Study Area can be found in Volume C-2000, "Definition of Existing Data Base for Water Quality," of the Study Task Report Series.

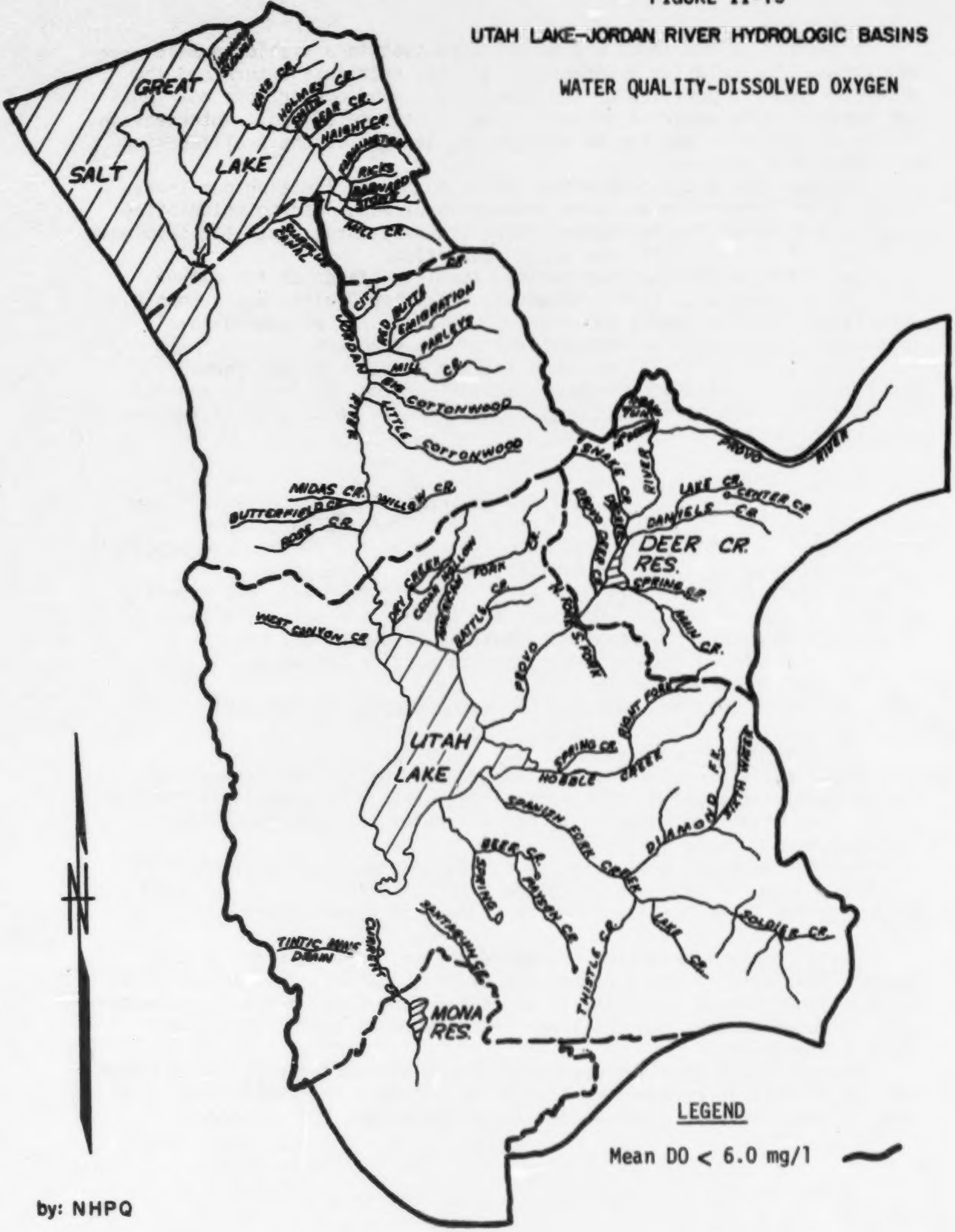
Davis County - Headwater streams draining the west slope of the Wasatch Mountains in Davis County are of high quality. As many of these streams flow through agricultural areas and then urban development, water quality deteriorates. In the lower reaches, most streams do not meet Class C standards.

Howard Slough does not meet the Class C standard for Total Coliforms and TDS as well as recommended levels for nitrates and phosphates. The same is true for Kays Creek which also violates the BOD standard.

FIGURE II-15

UTAH LAKE-JORDAN RIVER HYDROLOGIC BASINS

WATER QUALITY-DISSOLVED OXYGEN


GREAT
SALT
LAKE
KAYS CR.
HOLMES CR.
SHEPARD
BEAR CR.
HAIGHT CR.
FARMINGTON
RICKS
BARNARD
STONE
MILL CR.
SURPLUS CANAL
CITY CR.
RED BUTTE
EMIGRATION
PARLEYS
MILL CR.
JORDAN RIVER
BIG COTTONWOOD
LITTLE COTTONWOOD
MIDAS CR.
WILLOW CR.
BUTTERFIELD CR.
ROSE CR.
WEST CANYON CR.
DRY CREEK
CEDAR HOLLOW
AMERICAN FORK
BATTLE CR.
PROVO
N. FORK
S. FORK
SNAKE CR.
PROVO DEER CR.
RIVER
PROVO RIVER
LAKE CR.
CENTER CR.
DANIELS CR.
DEER CR. RES.
SPRING CR.
MAIN CR.
RIGHT FORK
SPRING CR.
HOBBLE CREEK
UTAH LAKE
DIAMOND FK.
SIXTH WATER
SPANISH FORK CREEK
BEER CR.
SPRING D
PAYSON CR.
THISTLE CR.
LAKE CR.
SOLDIER CR.
SANTAQUIN CR.
CURRANT CR.
TINTIC MINE DRAIN
MONA RES.
N

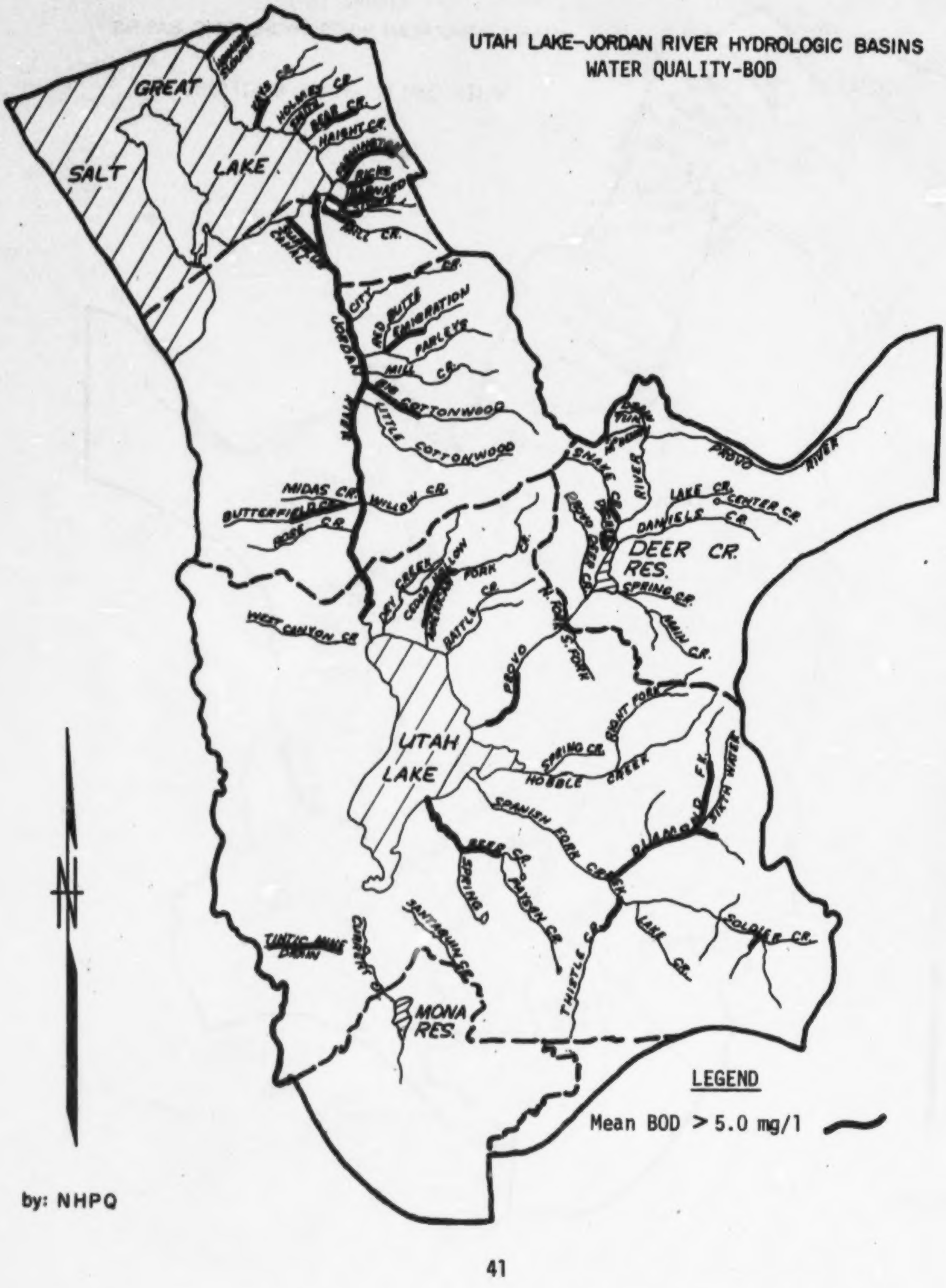
LEGEND

Mean DO < 6.0 mg/l 〰

by: NHPQ

FIGURE II-16

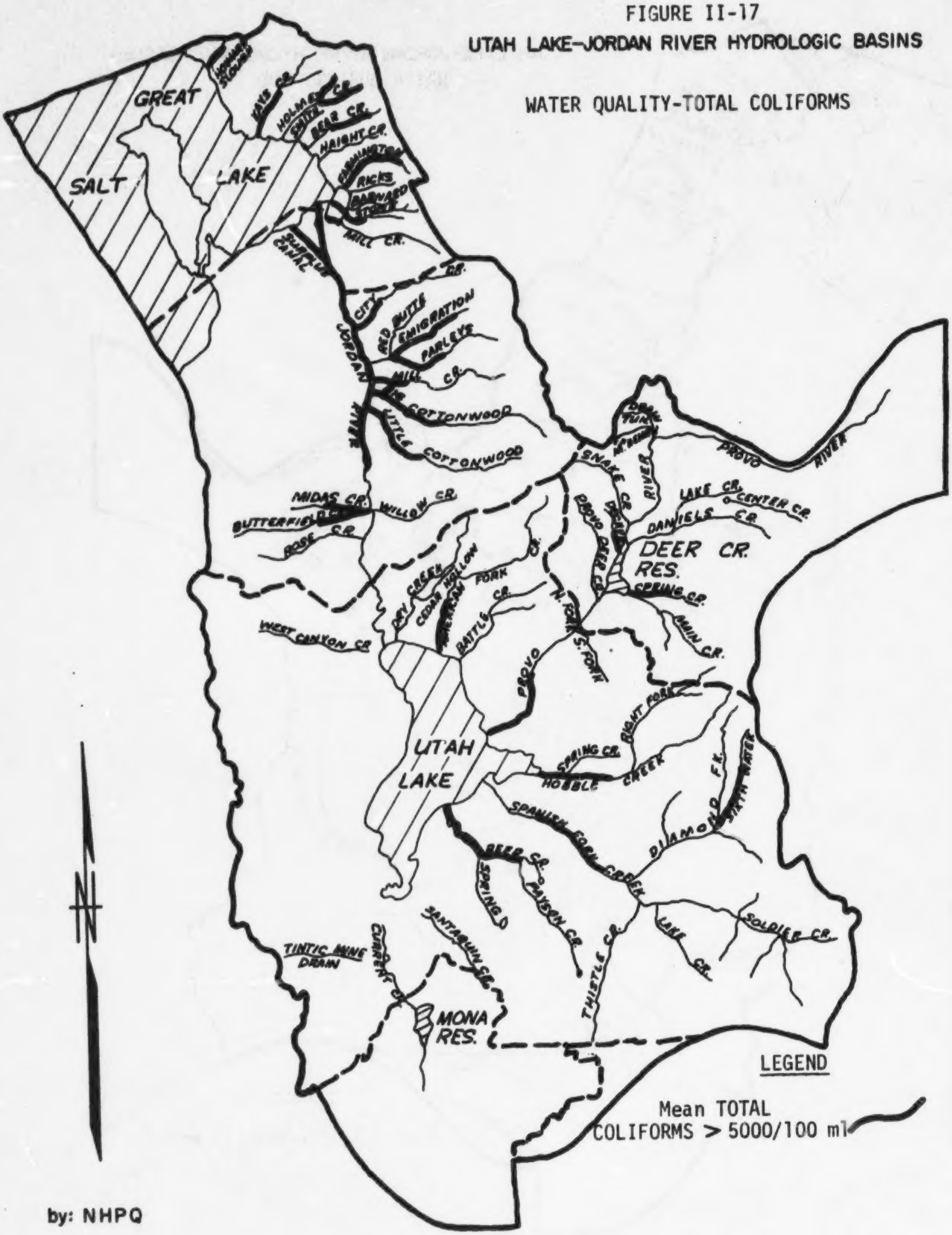
UTAH LAKE-JORDAN RIVER HYDROLOGIC BASINS
WATER QUALITY-BOD


GREAT SALT LAKE
HOLMES CR.
BEAR CR.
HEIGHT CR.
FARMINGTON
RICKS
BARNARD
MILL CR.
CANAL
CITY
RED BUTTE
EMIGRATION
PARLEYS
MILL CR.
BIG COTTONWOOD
LITTLE COTTONWOOD
JORDAN RIVER
MIDAS CR.
BUTTERFIELD CR.
WILLOW CR.
ROSE CR.
PROVO RIVER
SNAKE CR.
LAKE CR.
CENTER CR.
DANIELS CR.
DEER CR. RES.
SPRING CR.
MAIN CR.
WEST CANYON CR.
DRY CREEK
CEDAR HOLLOW
AMERICAN FORK
BATTLE CR.
N. FORK
S. FORK
PROVO
RIGHT FORK
UTAH LAKE
SPRING CR.
HOBBLE CREEK
SPANISH FORK CREEK
DIAMOND FK.
SIXTH WATER
BEER CR.
SPRING
PAYSON CR.
TINTIC DRAIN
CURRENT CR.
SANTAQUIN CR.
MONA RES.
THISTLE CR.
LAKE CR.
SOLDIER CR.
N
LEGEND
Mean BOD > 5.0 mg/l

by: NHPQ

FIGURE II-17
UTAH LAKE-JORDAN RIVER HYDROLOGIC BASINS

WATER QUALITY-TOTAL COLIFORMS

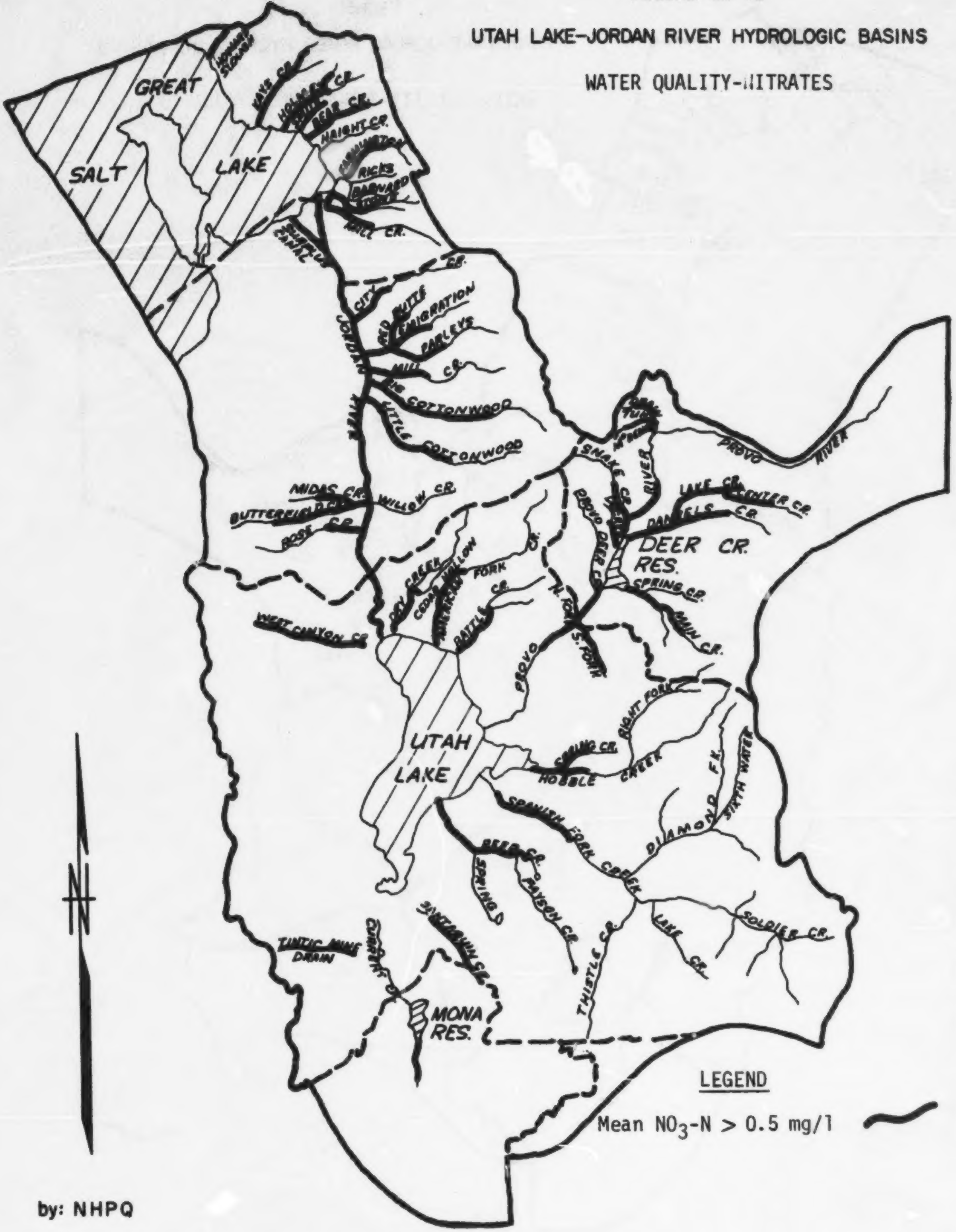

GREAT
SALT
LAKE
KAYS CR.
HOLMES CR.
SMITH
BEAR CR.
HAIGHT CR.
FARMINGTON
RICKS
BARNARD
STONE
MILL CR.
SURPLUS CANAL
CR.
CITY
RED BUTTE
EMIGRATION
PARLEYS
JORDAN
MILL CR.
BIG COTTONWOOD
RIVER
LITTLE COTTONWOOD
SNAKE CR.
RIVER
PROVO RIVER
LAKE CR.
CENTER CR.
DANIELS CR.
DEER CR. RES.
PROVO RIVER
DEER CR.
SPRING CR.
MAIN CR.
MIDAS CR.
WILLOW CR.
BUTTERFIELD
ROSE CR.
DRY CREEK
CEDAR HOLLOW
AMERICAN FORK
BATTLE CR.
CR.
N. FORK
S. FORK
WEST CANYON CR.
PROVO
RIGHT FORK
UTAH LAKE
SPRING CR.
HOBBLE CREEK
SPANISH FORK CREEK
DIAMOND FK.
SIXTH WATER
DEER CR.
SPRING D
PAYSON CR.
THISTLE CR.
LAKE CR.
SOLDIER CR.
TINTIC MINE DRAIN
CURRENT CR.
SANTAQUIN CR.
MONA RES.
N
LEGEND
Mean TOTAL COLIFORMS > 5000/100 ml

by: NHPQ

FIGURE II-18

UTAH LAKE-JORDAN RIVER HYDROLOGIC BASINS

WATER QUALITY-NITRATES


GREAT
SALT
LAKE
KAYS CR.
HOLMES CR.
BEAR CR.
HAIGHT CR.
FARMINGTON
RICKS
BARNARD
MILL CR.
SURPLUS CANAL
CITY CR.
RED BUTTE
EMIGRATION
PARLEYS
MILL CR.
BIG COTTONWOOD
LITTLE COTTONWOOD
JORDAN RIVER
MIDAS CR.
BUTTERFIELD CR.
ROSE CR.
WILLOW CR.
DRY CREEK
CEDAR
AMERICAN FORK
BATTLE CR.
WEST CANYON CR.
SNAKE CR.
PROVO RIVER
LAKE CR.
CENTER CR.
DANIELS CR.
DEER CR.
RES.
SPRING CR.
MAIN CR.
N. FORK
S. FORK
PROVO
UTAH
LAKE
RIGHT FORK
SPRING CR.
HOBBLE CREEK
SIXTH WATER
DIAMOND FK.
SPANISH FORK CREEK
BEER CR.
SPRING
PAYSON CR.
THISTLE CR.
LAKE CR.
SOLDIER CR.
TINTIC MINE DRAIN
CURRANT CR.
SANTAQUIN CR.
MONA
RES.
N

LEGEND

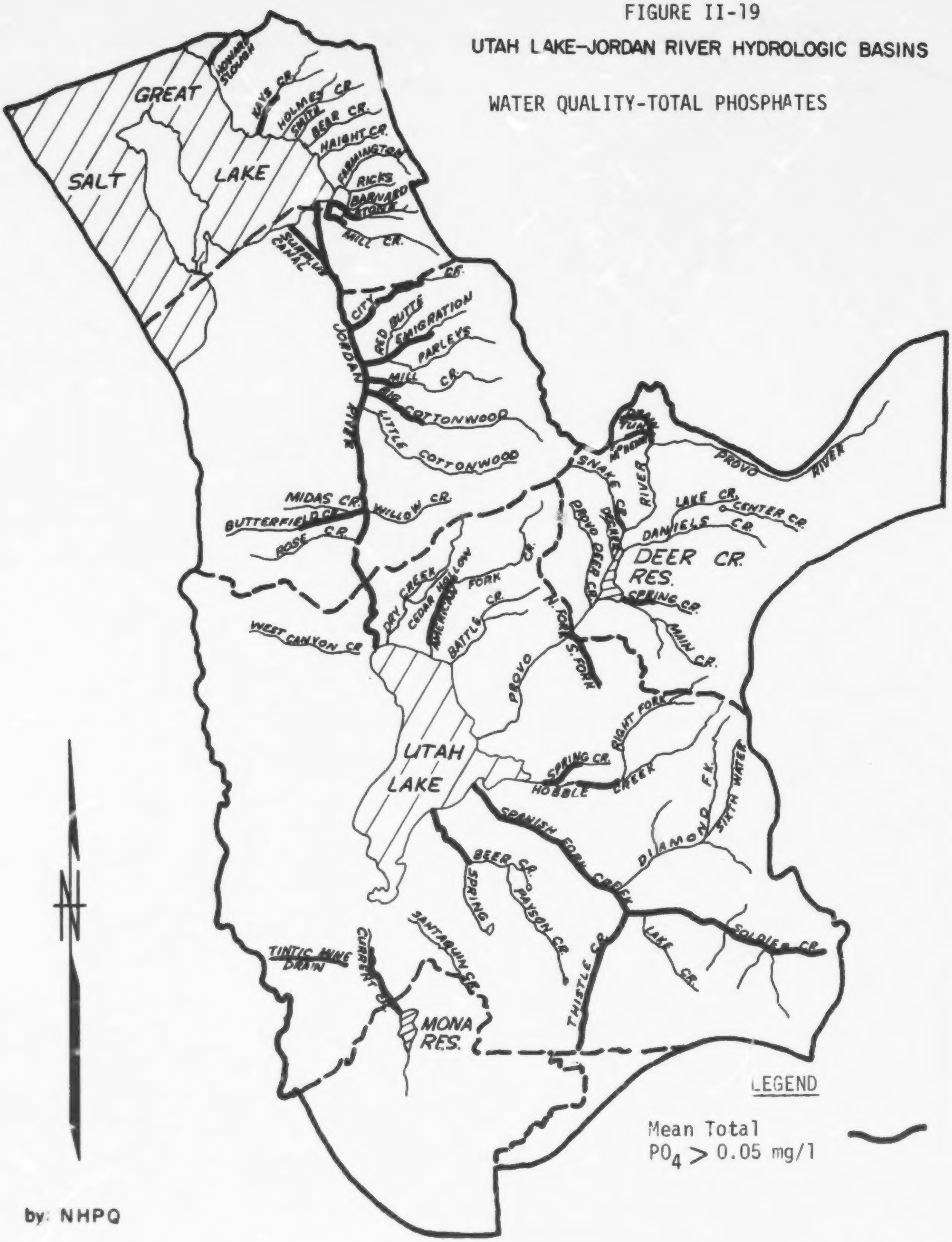
Mean NO_3-N > 0.5 mg/l

by: NHPQ

FIGURE II-19

UTAH LAKE-JORDAN RIVER HYDROLOGIC BASINS

WATER QUALITY-TOTAL PHOSPHATES

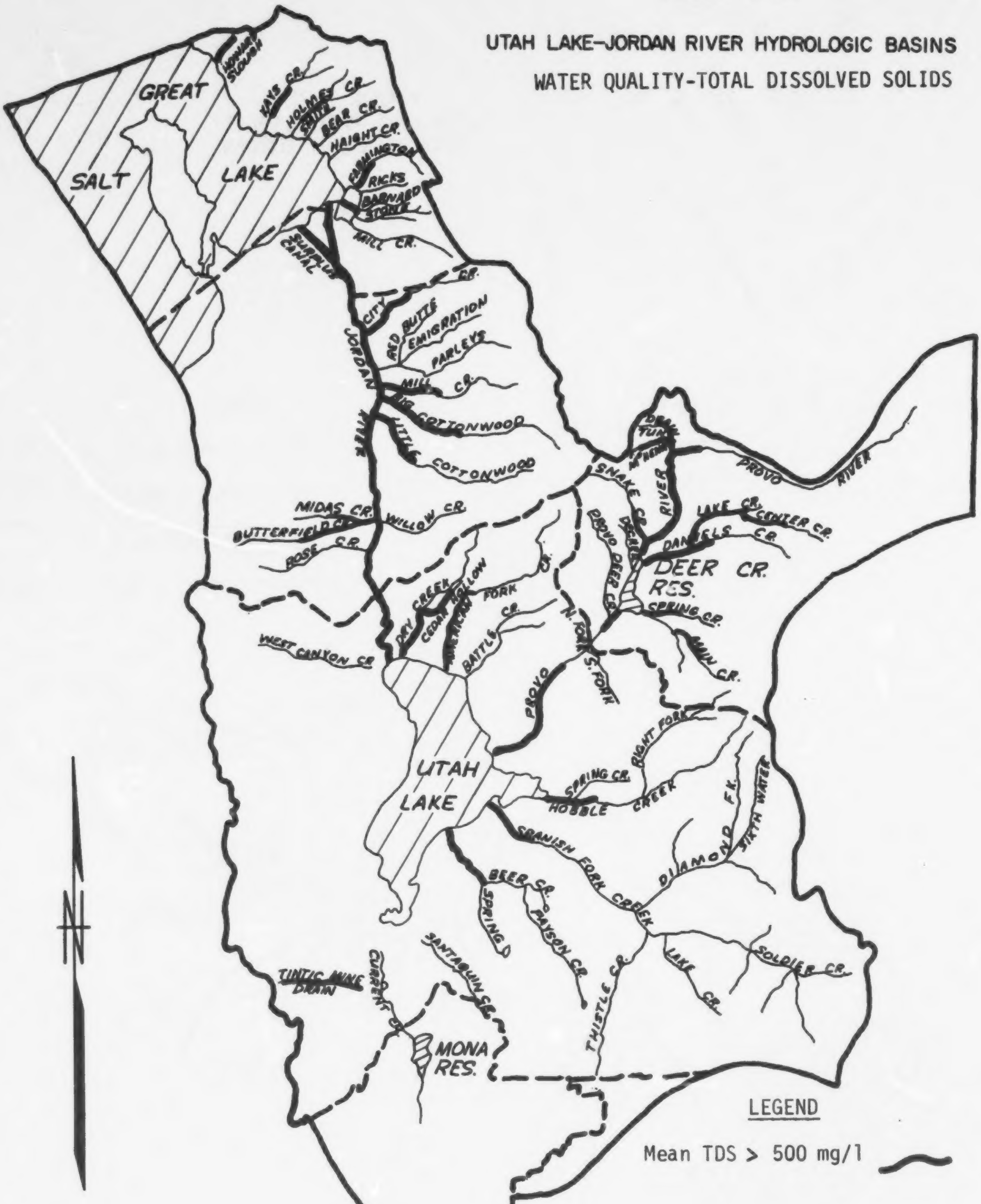

GREAT SALT LAKE
HOWARD SLOUGH
KAYS CR.
HOLMES CR.
SMITH
BEAR CR.
HAIGHT CR.
FARMINGTON
RICKS
BARNARD
STONE
MILL CR.
SURPLUS CANAL
CITY CR.
RED BUTTE
EMIGRATION
PARLEYS
MILL CR.
BIG COTTONWOOD
LITTLE COTTONWOOD
JORDAN RIVER
MIDAS CR.
BUTTERFIELD CR.
WILLOW CR.
ROSE CR.
WEST CANYON CR.
DRY CREEK
CEDAR HOLLOW
AMERICAN FORK
BATTLE CR.
N. FORK
S. FORK
PROVO
DRAW TUNNEL
WEBER
SNAKE CR.
RIVER
PROVO DEER CR.
DECKER
PROVO RIVER
LAKE CR.
CENTER CR.
DANIELS CR.
DEER CR. RES.
SPRING CR.
MAIN CR.
UTAH LAKE
RIGHT FORK
SPRING CR.
HOBBLE CREEK
SIXTH WATER
DIAMOND FK.
SPANISH FORK CREEK
BEER CR.
SPRING
PAYSON CR.
SANTAQUIN CR.
CURRENT CR.
TINTIC MINE DRAIN
MONA RES.
THISTLE CR.
LAKE CR.
SOLDIER CR.
N
LEGEND
Mean Total
$PO_4 > 0.05$ mg/l

by: NHPQ

FIGURE II-20

UTAH LAKE–JORDAN RIVER HYDROLOGIC BASINS

WATER QUALITY-TOTAL DISSOLVED SOLIDS


GREAT
SALT
LAKE
HOWARD SLOUGH
KAYS CR.
HOLMES CR.
SMITH
BEAR CR.
HAIGHT CR.
FARMINGTON
RICKS
BARNARD
STONE
MILL CR.
SURPLUS CANAL
CITY CR.
RED BUTTE
EMIGRATION
PARLEYS
JORDAN RIVER
MILL CR.
BIG COTTONWOOD
LITTLE COTTONWOOD
SNAKE CR.
DRAIN TUN.
RIVER
PROVO RIVER
LAKE CR.
CENTER CR.
DANIELS CR.
DEER CR. RES.
PROVO DEER CR.
SPRING CR.
MAIN CR.
MIDAS CR.
WILLOW CR.
BUTTERFIELD CR.
ROSE CR.
DRY CREEK
CEDAR HOLLOW
AMERICAN FORK
BATTLE CR.
CR.
N. FORK
S. FORK
PROVO
WEST CANYON CR.
UTAH LAKE
RIGHT FORK
SPRING CR.
HOBBLE CREEK
DIAMOND FK.
SIXTH WATER
SPANISH FORK CREEK
BEER CR.
SPRING
PAYSON CR.
SANTAQUIN CR.
CURRENT CR.
TINTIC MINE DRAIN
MONA RES.
THISTLE CR.
LAKE CR.
SOLDIER CR.
N
LEGEND
Mean TDS > 500 mg/l

by: NHPQ

FIGURE II-21
UTAH LAKE-WATER QUALITY
MEAN DISSOLVED OXYGEN

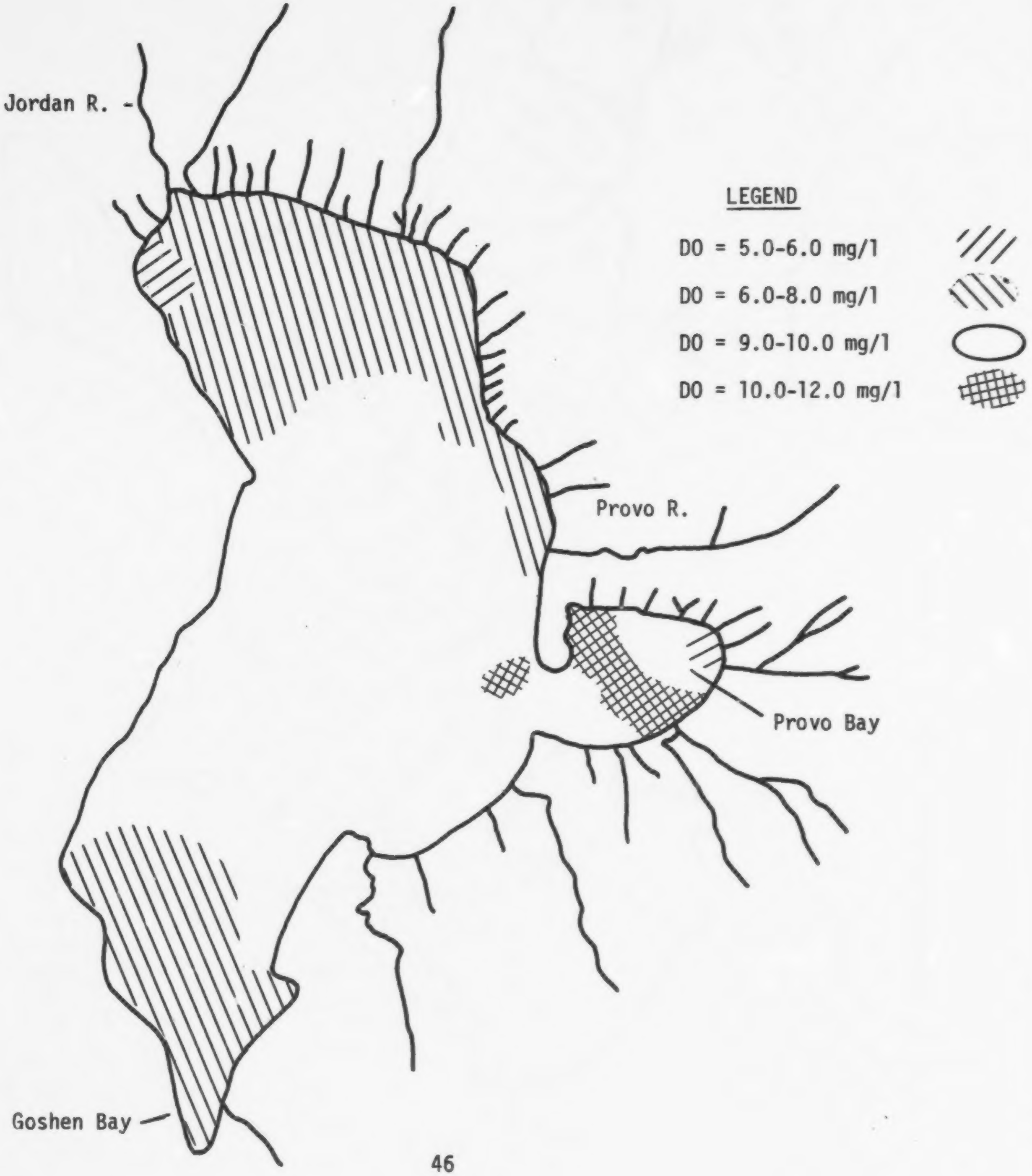

Jordan R.
LEGEND
DO = 5.0-6.0 mg/l ▨
DO = 6.0-8.0 mg/l ▧
DO = 9.0-10.0 mg/l ○
DO = 10.0-12.0 mg/l ▦
Provo R.
Provo Bay
Goshen Bay

FIGURE II-22
UTAH LAKE-WATER QUALITY
MEAN BIOCHEMICAL OXYGEN
DEMAND

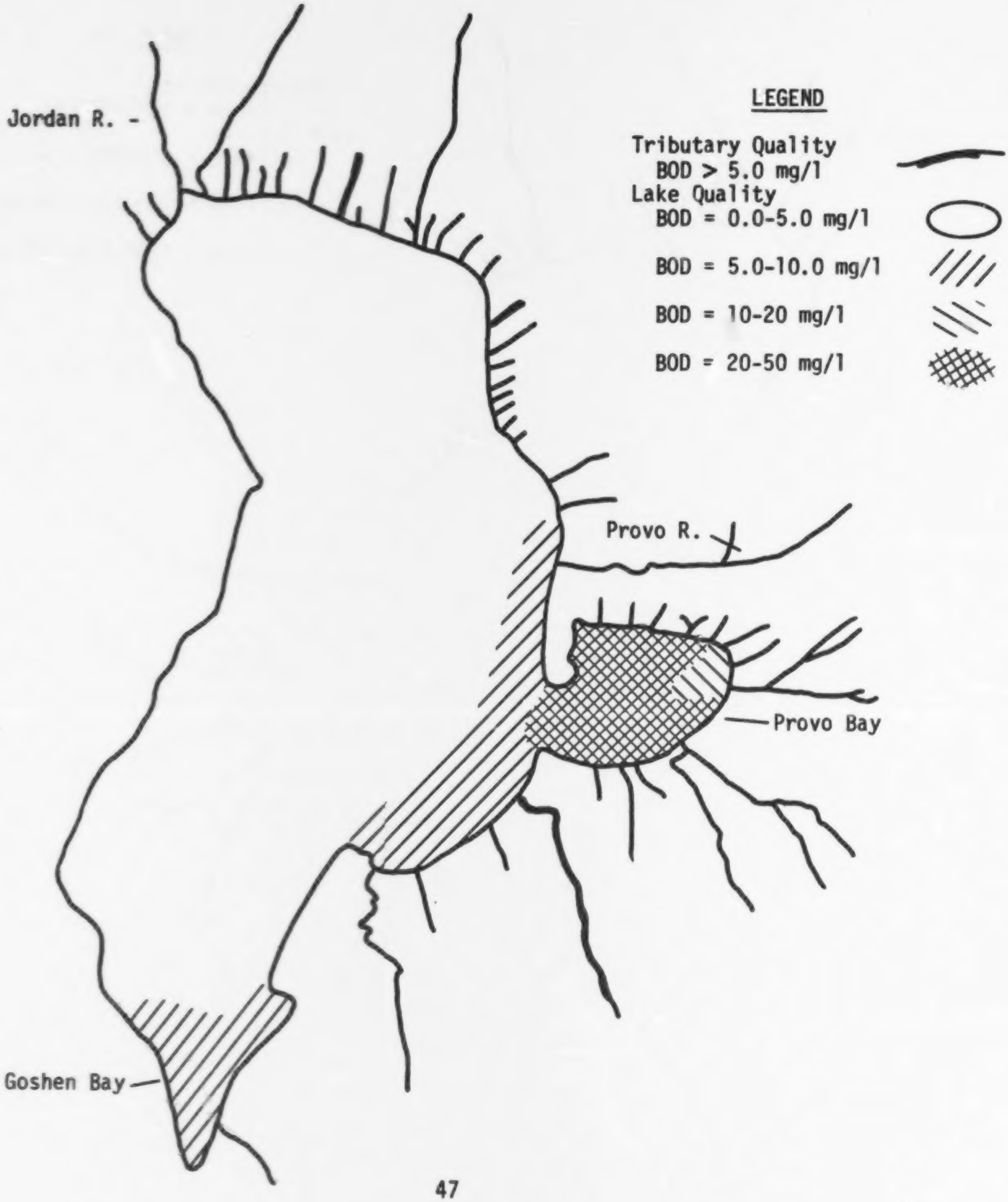

LEGEND
Tributary Quality
BOD > 5.0 mg/l
Lake Quality
BOD = 0.0-5.0 mg/l
BOD = 5.0-10.0 mg/l
BOD = 10-20 mg/l
BOD = 20-50 mg/l
Jordan R.
Provo R.
Provo Bay
Goshen Bay

FIGURE II-23
UTAH LAKE-WATER QUALITY
MEAN TOTAL COLIFORM

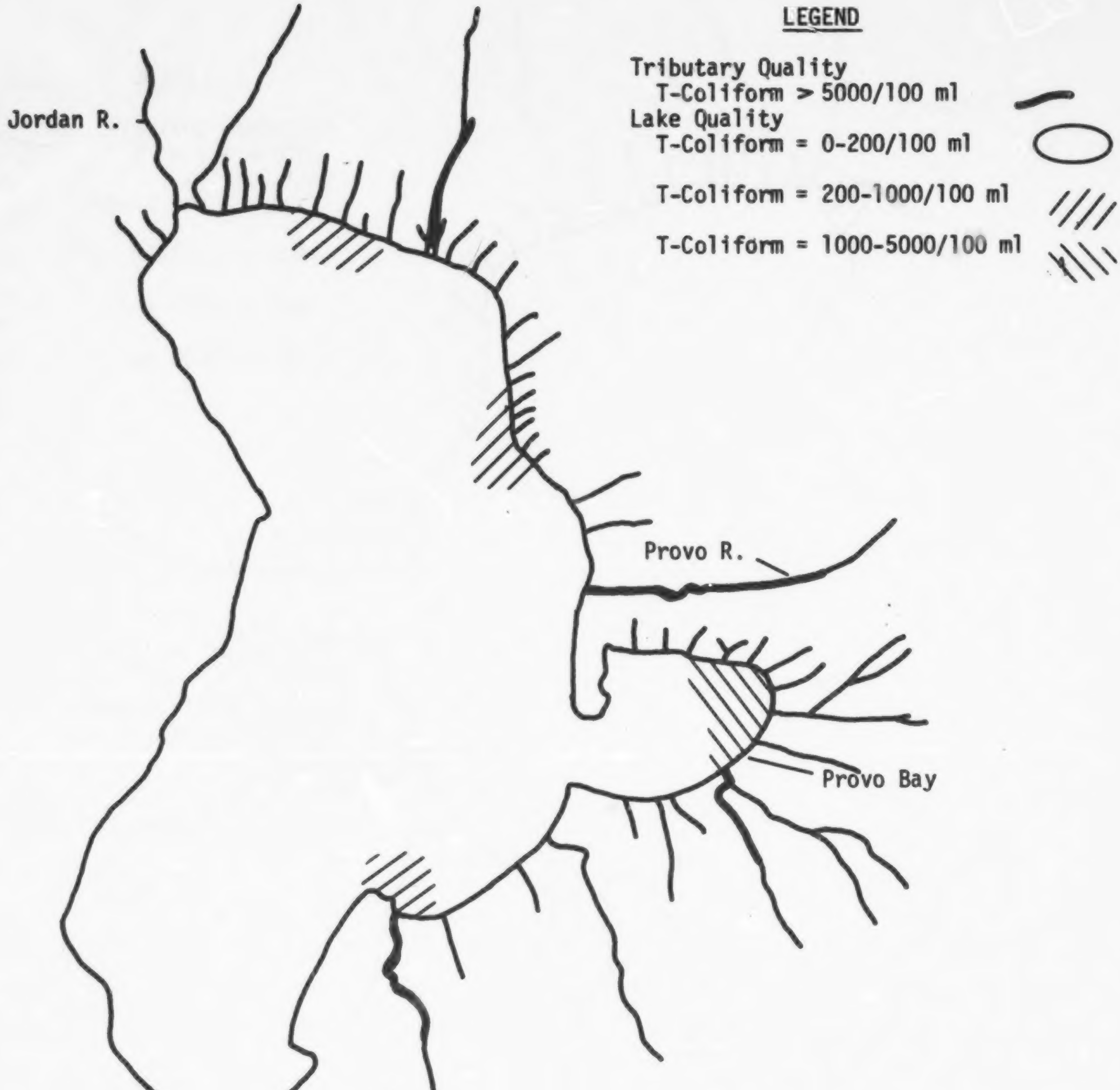

LEGEND
Tributary Quality
T-Coliform > 5000/100 ml
Lake Quality
T-Coliform = 0-200/100 ml
T-Coliform = 200-1000/100 ml
T-Coliform = 1000-5000/100 ml
Jordan R.
Provo R.
Provo Bay
Goshen Bay

FIGURE II-24
UTAH LAKE-WATER QUALITY
MEAN NITRATE

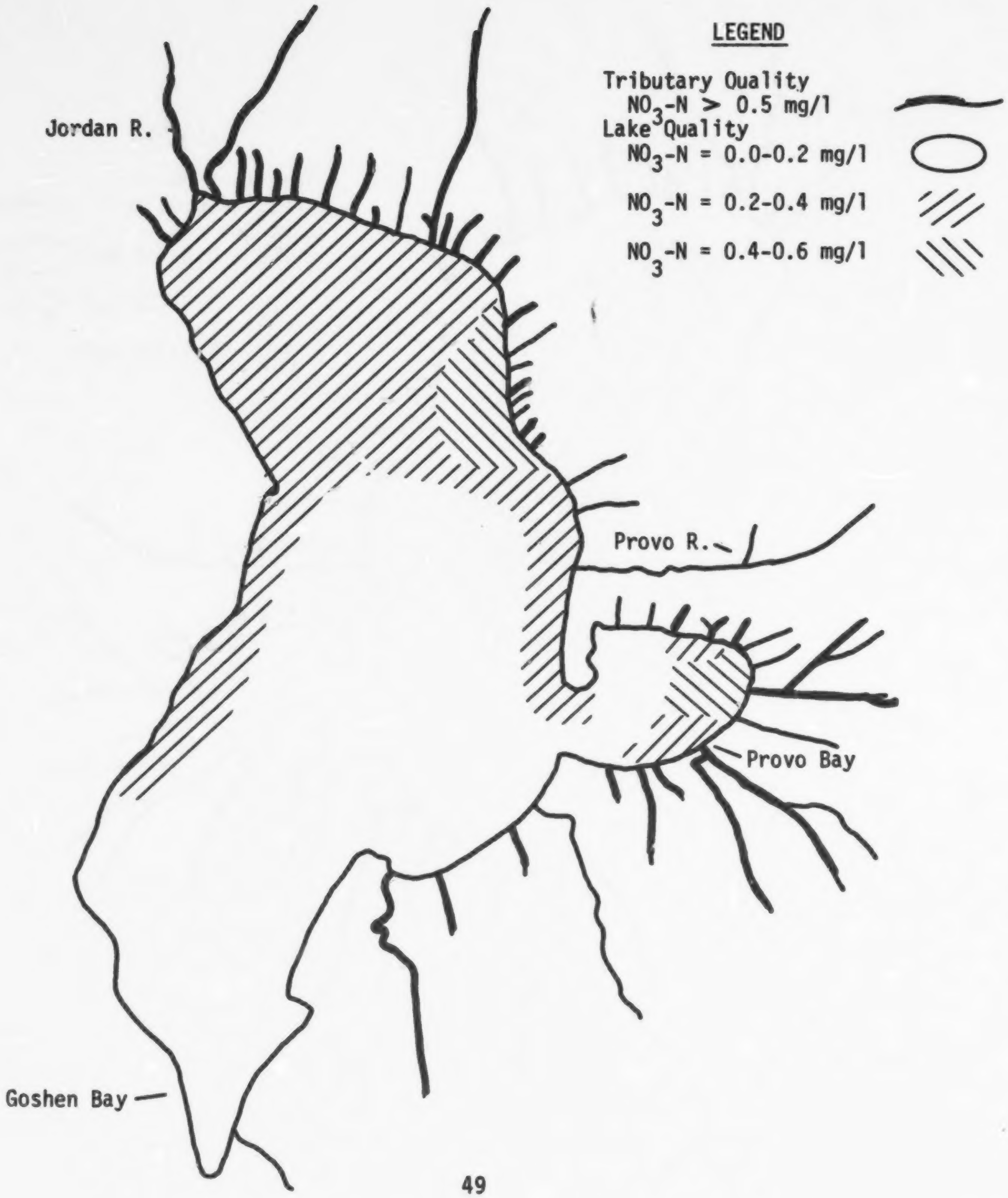

LEGEND
Tributary Quality
NO3-N > 0.5 mg/l
Lake Quality
NO3-N = 0.0-0.2 mg/l
NO3-N = 0.2-0.4 mg/l
NO3-N = 0.4-0.6 mg/l
Jordan R.
Provo R.
Provo Bay
Goshen Bay

FIGURE II-25
UTAH LAKE-WATER QUALITY
MEAN TOTAL PHOSPHATE

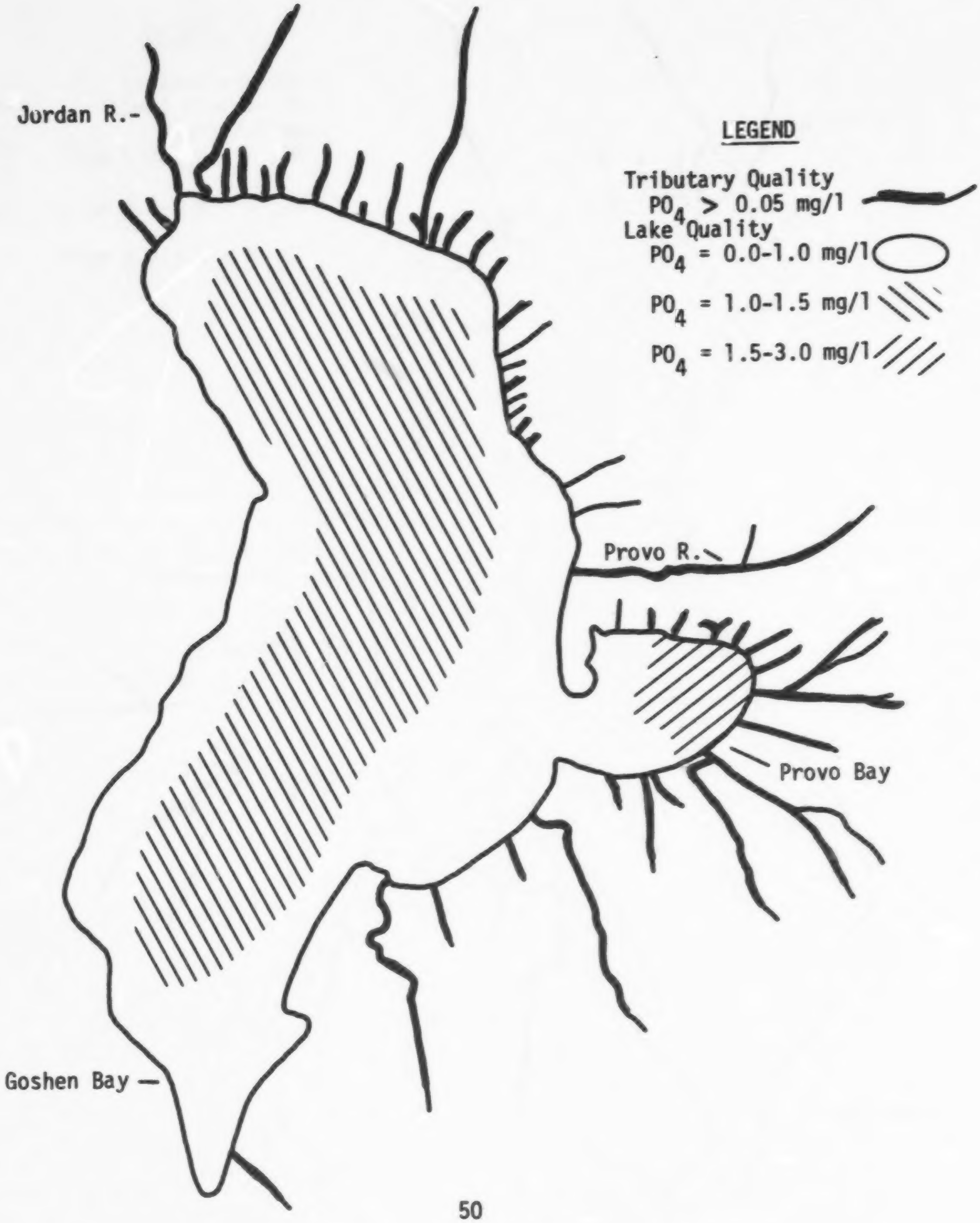
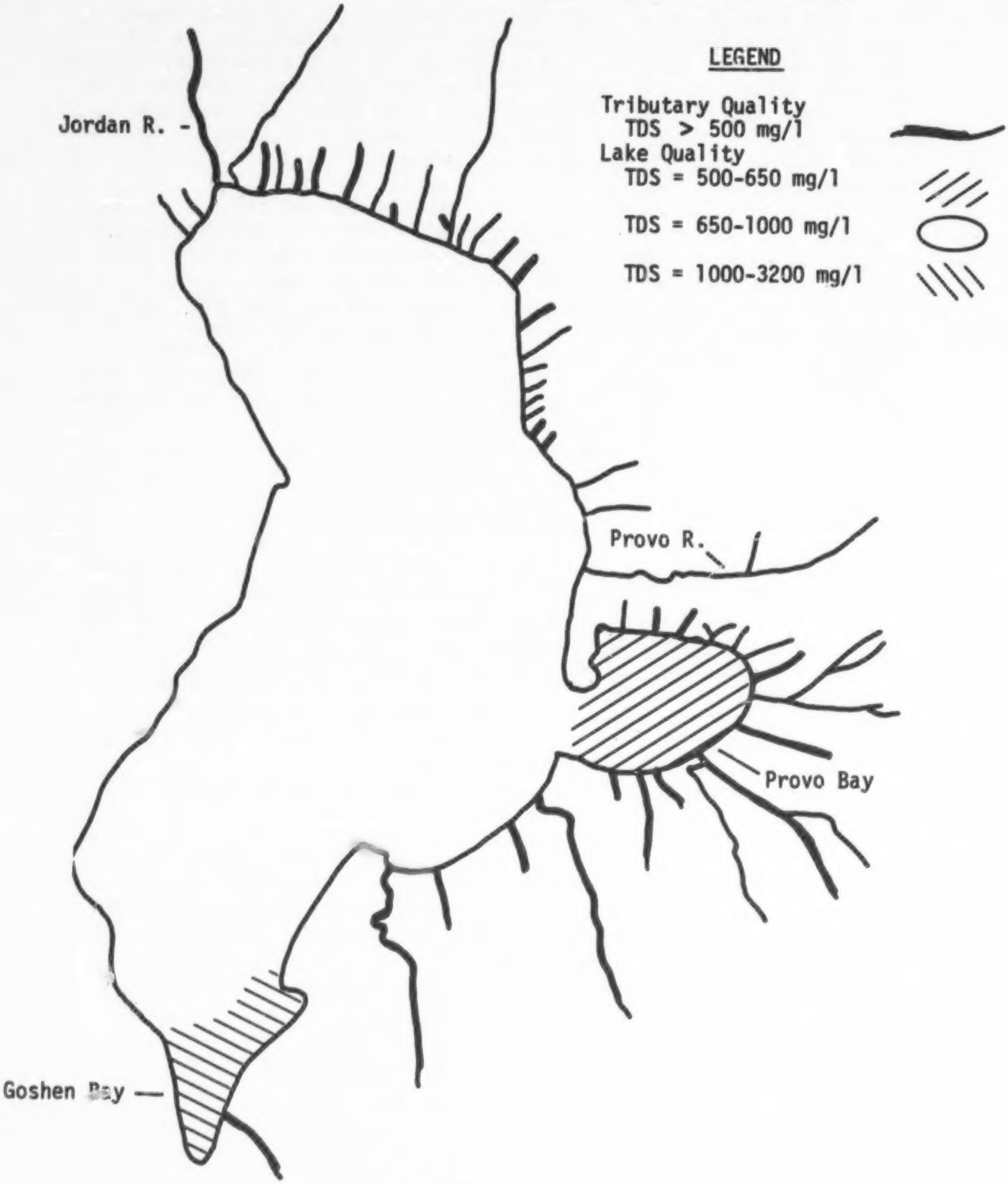

Jordan R.
LEGEND
Tributary Quality
PO4 > 0.05 mg/l
Lake Quality
PO4 = 0.0-1.0 mg/l
PO4 = 1.0-1.5 mg/l
PO4 = 1.5-3.0 mg/l
Provo R.
Provo Bay
Goshen Bay

FIGURE II-26
UTAH LAKE-WATER QUALITY
MEAN TOTAL DISSOLVED SOLIDS


LEGEND
Tributary Quality
TDS > 500 mg/l
Lake Quality
TDS = 500-650 mg/l
TDS = 650-1000 mg/l
TDS = 1000-3200 mg/l
Jordan R.
Provo R.
Provo Bay
Goshen Bay

BOD standards are also violated in the lower reaches of Bear Creek, Farmington Creek, Ricks Creek, Barnard Creek, Stone Creek, and Mill Creek. Of these, the water quality in Bear Creek, Farmington Creek, Stone Creek, and Mill Creek is also in violation of Total Coliform and Nitrate levels. Phosphate levels are violated in Farmington and Stone Creeks and TDS levels are excessive in Stone and Mill Creeks.

Salt Lake County - Water quality problems in Salt Lake County are similar to those in Davis County. Streams originating in the Wasatch Mountains manifest high water quality in the headwater reaches but deteriorate in quality as they flow through rural and urban areas.

Except for the lower part of the Jordan River, all Salt Lake County streams meet or exceed the Class CC DO standard of 6.0 mg/l. Mean DO levels in the lower Jordan River are between 3.5 and 5.0 mg/l with observed minimum values as low as 2.5 mg/l.

All of the Jordan River in Salt Lake County and the Surplus Canal violate all Class C standards (except DO) as well as the recommended values for nitrates and phosphates. The same is true for the lower reaches of Big Cottonwood Creek and Butterfield Creek.

Emigration Creek also manifests water quality problems. Emigration Creek, above the confluence with Red Butte and Parleys Creek, is in violation of the BOD, Total Coliform, nitrate, and TDS standards. Nitrate and TDS levels are also excessive below the confluence. Red Butte Creek and Parleys Creek violate nitrate levels and Parleys Creek also violates Total Coliform standards.

Little Cottonwood Creek and Midas Creek are in violation of the Total Coliform standard for Class C waters as well as the recommended values for nitrate and phosphate. Mill Creek and City Creek manifest the identical problem and also have excessive TDS levels.

Utah County - Significant water quality problems in Utah County surface streams are apparent in the American Fork River, Beer Creek, Jordan River, Provo River, Hobble Creek, Spanish Fork River, and the Tintic Mine Drainage. The American Fork River and Beer Creek violate all Class C standards. The Jordan River manifests excessive BOD, nitrates, phosphates, and TDS. The same is true of the Tintic Mine Drainage. The Provo River manifests large concentrations of all parameters except TDS. Hobble Creek and Spanish Fork exhibit significant levels of all constituents except BOD.

Notwithstanding the above, all surface streams in Utah County meet or exceed the Class C DO standard.

Utah Lake is the major surface water in Utah County. It is the final receiving water for all surface streams in the County except the Jordan River which is the major drainage for Utah Lake. Except for high phosphate and TDS levels, the main Lake body meets or exceeds Class CW standards. The same is not true of the principal bays and areas around polluted tributaries.

Water in Provo Bay does not mix well with the remainder of Utah Lake. As a result of this and significant tributary drainage, sections of Provo Bay do not meet Class CW standards. DO levels between 5.0 and 6.0 mg/l have been measured in the far eastern end of Provo Bay. BOD levels in most of the Bay are between 20 and 50 mg/l. The eastern end of the Bay also manifests high nitrate and phosphate levels. In contrast to the remainder of the Lake, Provo Bay exhibits the lowest TDS concentrations, 500 to 650 mg/l.

Goshen Bay exhibits water quality problems similar to Provo Bay. BOD levels are between 5.0 to 10.0 mg/l in Goshen Bay. However, because of the lack of significant tributary flow and underlying salt falts, Goshen Bay has extremely high TDS concentrations, ranging from 1,000 to 3,200 mg/l.

Wasatch County - Although water quality problems are limited in Wasatch County, the use of surface waters for water supply magnify the concern for the quality of these waters. The most significant problem seems to be excessive nutrient levels in streams entering Deer Creek Reservoir, such as Spring Creek, Daniels Creek, Center Creek, Lake Creek, and Snake Creek as well as the upper Provo River and its tributaries. These inputs also serve to increase nitrate and phosphate levels below Deer Creek Reservoir. Decker Creek and Spring Creek also manifest Total Coliform standards in excess of Class C water.

Air Quality

Information on existing air quality and air quality problem areas is presented in terms of two of the numerous possible air pollutants, carbon monoxide (CO) and total suspended particulates (TSP) because they are pollutants that have recognized health effects, can be modelled with some accuracy, and are closely related to urban activity and growth.

Sources which emit air pollutants in general and CO and TSP in particular can be classified as point, line, and area sources as described below.

- Point sources: These are large single stack emitters such as power plants, steel mills, etc., which emit more than 12 tons/year of a pollutant.
- Line sources: These are major roads carrying large volumes of automotive traffic along which individual vehicles move thereby creating lines of pollutant emissions.
- Area sources: These are made up of many emitters not large enough to be classified as points or lines. They are averaged over a small geographic area. Typically they include residential area space heating and traffic on streets not classified as line sources.

To aid the reader in understanding the character of air quality in the Study Area, the presentation of existing air quality is prefaced by a discussion of these two air pollutants.

Carbon Monoxide (CO)

Motor vehicle traffic along heavily traveled highways is usually the predominant source of urban air pollution. The major pollutants emitted from motor vehicles are carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NO_x). The last two react photochemically in the formation of smog according to the relative concentrations of various air pollutants and the occurrence of certain meteorological conditions, particularly sunlight. The incomplete combustion of carbonaceous fuels produces carbon monoxide (CO), and the automobile is the primary source of this gas in an urban environment. Carbon monoxide is a relatively stable gas and does not appreciably take part in the photochemical process; however, CO is a poisonous inhalant. No other toxic gaseous air pollutant is found at such relatively high concentrations in urban atmospheres. It is dangerous because it has a strong affinity for hemoglobin, which carries oxygen to body tissues.

Because CO is relatively chemically stable, comes mostly from motor vehicles, and can be measured easily in the atmosphere, the concentration of CO represents a good basis for air quality analysis. Additionally, CO is closely related to urban activity and growth making it a good indicator of the impact of land use plans.

Reductions in CO concentrations are required by the Utah State Implementation Plan for air quality attainment and maintenance. EPA standards for CO are couched in terms of primary and secondary standards. The primary standard is designed to protect human welfare, thus it refers to possible damage to plants, animals, and materials. These CO standards are:

Averaging Time	Primary Standard		Secondary Standard	
	ug/m^3	ppm	ug/m^3	ppm
1 hour	40,000	35	40,000	35
8 hour	10,000	9	10,000	9

These standards represent values not to be exceeded more than once per year.

Total Suspended Particulates (TSP)

Total suspended particulates (TSP) are a significant indicator of air quality because of their toxic effects on human beings and animals as well as their corrosive effects on many materials and the reduction in visibility and aesthetics in areas of high concentration. Respiratory illnesses have a pronounced association with particulate concentrations, and adverse health effects have been noted for annual geometric mean levels of as little as 80 micrograms per cubic meter (ug/m^3). Historically, several communities in the Study Area are above or near this level. Particulates also are important in health considerations because they interact with other pollutants, particularly SO_2. They act as nucleation sites in the atmosphere for forming sulfuric acid mist and they increase respiratory problems associated with SO_2.

Like CO, TSP concentrations are indicators of urban activity and growth and, as such, EPA has set the primary and secondary TSP standards presented below:

Averaging Time	Primary Standard ug/m^3	Secondary Standard ug/m^3
24 hour	260	150
1 year	75	60

The 24 hour average values are not to be exceeded more than once per year while the one year standard represents a geometric mean not to be exceeded.

Other Related Air Quality Factors

For a complete understanding of the character of air quality in the Study Area, it is important to have some perception of the factors, other than pollutant concentrations and standards, which affect air quality. Principle among these factors are the topography and meterology of the Study Area and the types of pollutant sources.

Topographical Factors - Based on an analysis of historical air quality data, topographical maps, and field review, it can be concluded that the Study Area can be divided into two separate air basins, each having different and distinct characteristics. These regions are the Salt Lake City basin and the Provo basin, with the dividing line being the Traverse Mountains (see Figure II-5).

The Salt Lake City basin is relatively flat but with the terrain generally sloping toward the Great Salt Lake. The primary metropolitan area in the basin is Salt Lake City which is at the eastern edge against the Wasatch Mountains. It has a population of about 190,000 and is at an altitude of approximately 4,250 feet above sea level. The surrounding mountains form barriers to wider dispersal of air pollutants and they influence wind, weather, and climate in the basin, which are important in establishing its air quality.

The Provo basin is also relatively flat and slopes toward Utah Lake. The City of Provo, which is the main metropolitan area in the basin, is at the eastern side against the Wasatch Mountains from which canyons enter into the basin. The metropolitan area has a population of about 65,000 and is at an altitude of approximately 4,550 feet above sea level. In most important respects this basin is like and behaves similar to the Salt Lake City basin. Conclusions about effects of topography on air pollution in the Provo basin are essentially like those of the Salt Lake City basin.

Meteorological Factors - Of considerable importance to the problem of air pollution in the Salt Lake City basin is the fact that anti-cyclonic systems are frequent during Fall and Winter causing stagnant high pressure to persist for days or weeks. Strong inversion conditions result from this system and related cooling of the earth's surface. These strong inversions and relatively low wind speeds cause unfavorable conditions for air quality.

Inversions occur approximately 80 percent of mornings in the Salt Lake City basin especially during Fall and Winter. From March through October the air tends to be stable during the night and unstable during daytime. From November through February persistent inversions tend to exist. Wind directions are not generally constant over the region for periods of hours or a day.

Meteorological features in the Provo basin are similar to those of the Salt Lake City basin. They are altered in detail only by the slight differences in altitude and topography between the two basins.

Source Factors - Each of the three types of sources, point, line, and area sources, emit CO. The greatest contribution is from mobile sources, particularly automobiles. In the Salt Lake City air basin, approximately 92 percent of all carbon monoxide emissions come from line sources, approximately 3 percent from point sources, and about 5 percent from area sources. In the Provo air basin, point sources are more important, accounting for about 15 percent of all emissions, with line sources accounting for about 80 percent, and area sources about 5 percent of emissions. As noted previously, area sources include traffic on streets not classified as line sources, so automotive emissions are even more dominant than might appear from these statistics.

Total suspended particulate matter (TSP) is emitted by a variety of sources in the Study Area. Particulate emissions originating from line sources include exhaust emissions, emissions from tire wear, fugitive dust from unpaved roads, emissions resulting from highway construction, and emissions resulting from the use of sanding for ice and snow control. Over 10,000 line sources were included in the source inventory, with each segment of highway in the area being treated as a composite source.

Particulate emissions from point sources include emissions from space heating and industrial processes. Smelters, steel mills, power plants, refineries, and asphalt batch plants are primary sources of particulate emissions in the Study Area.

Particulate emissions from area sources arise from space heating of homes and commercial facilities; fugitive dust from agricultural operations; emissions from local vehicle traffic; and fugitive dust from residential, industrial, and commercial construction activities.

Under this system of classification, about 26 percent of TSP emissions come from line sources, about 48 percent from point sources, and about 26 percent from area sources.

Existing Air Quality

Monitored air quality data for CO and TSP are available from 13 stations operated by the Utah State Division of Health. The locations of these monitoring stations are illustrated in Figures II-27 and II-28. Six of these stations are located in the Salt Lake City air basin, and seven stations monitor air quality in the Provo basin.

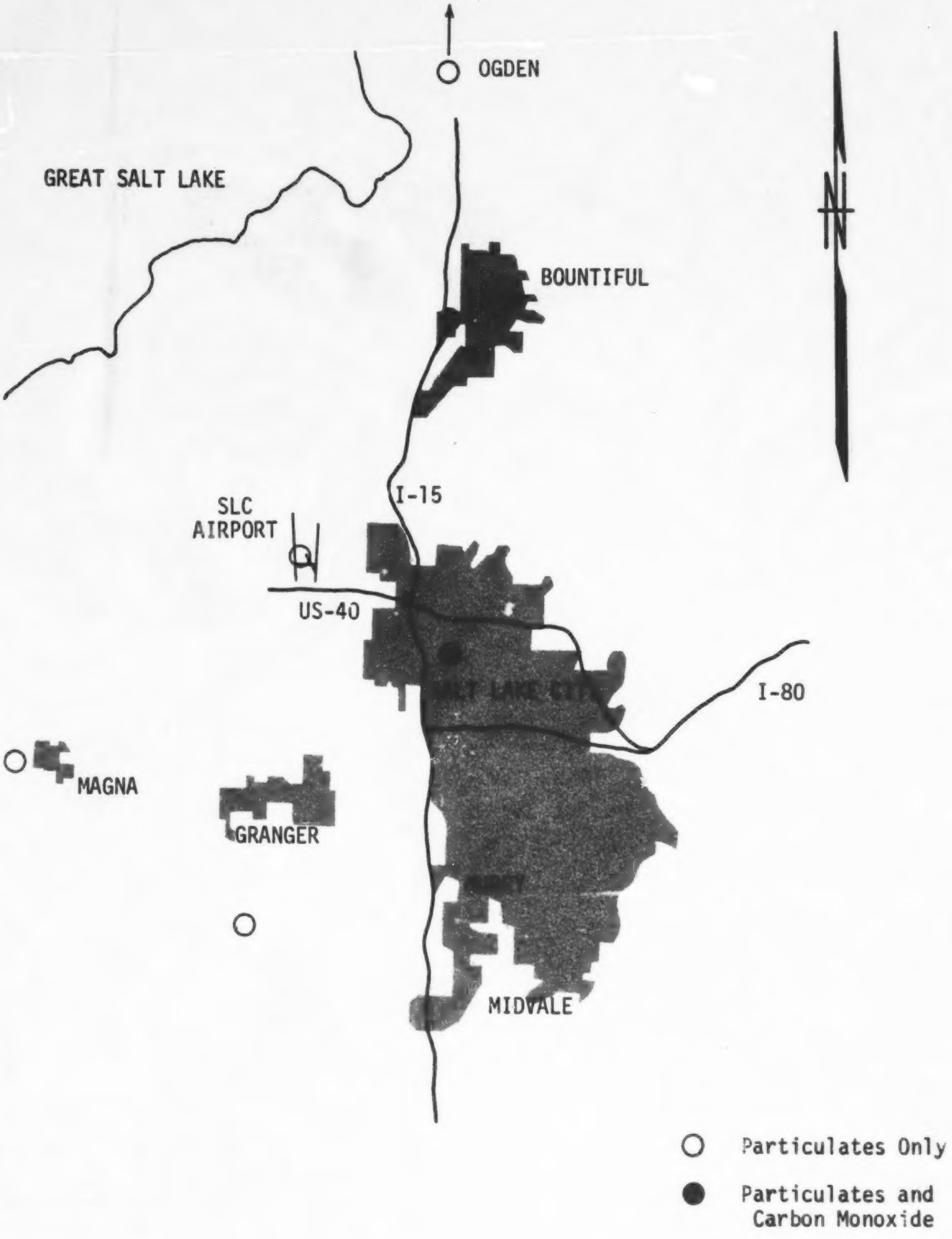

OGDEN
GREAT SALT LAKE
N
BOUNTIFUL
I-15
SLC AIRPORT
US-40
SALT LAKE CITY
I-80
MAGNA
GRANGER
MURRAY
MIDVALE
○ Particulates Only
● Particulates and Carbon Monoxide

FIGURE II-27

AIR POLLUTANT MONITORING STATIONS

SALT LAKE CITY

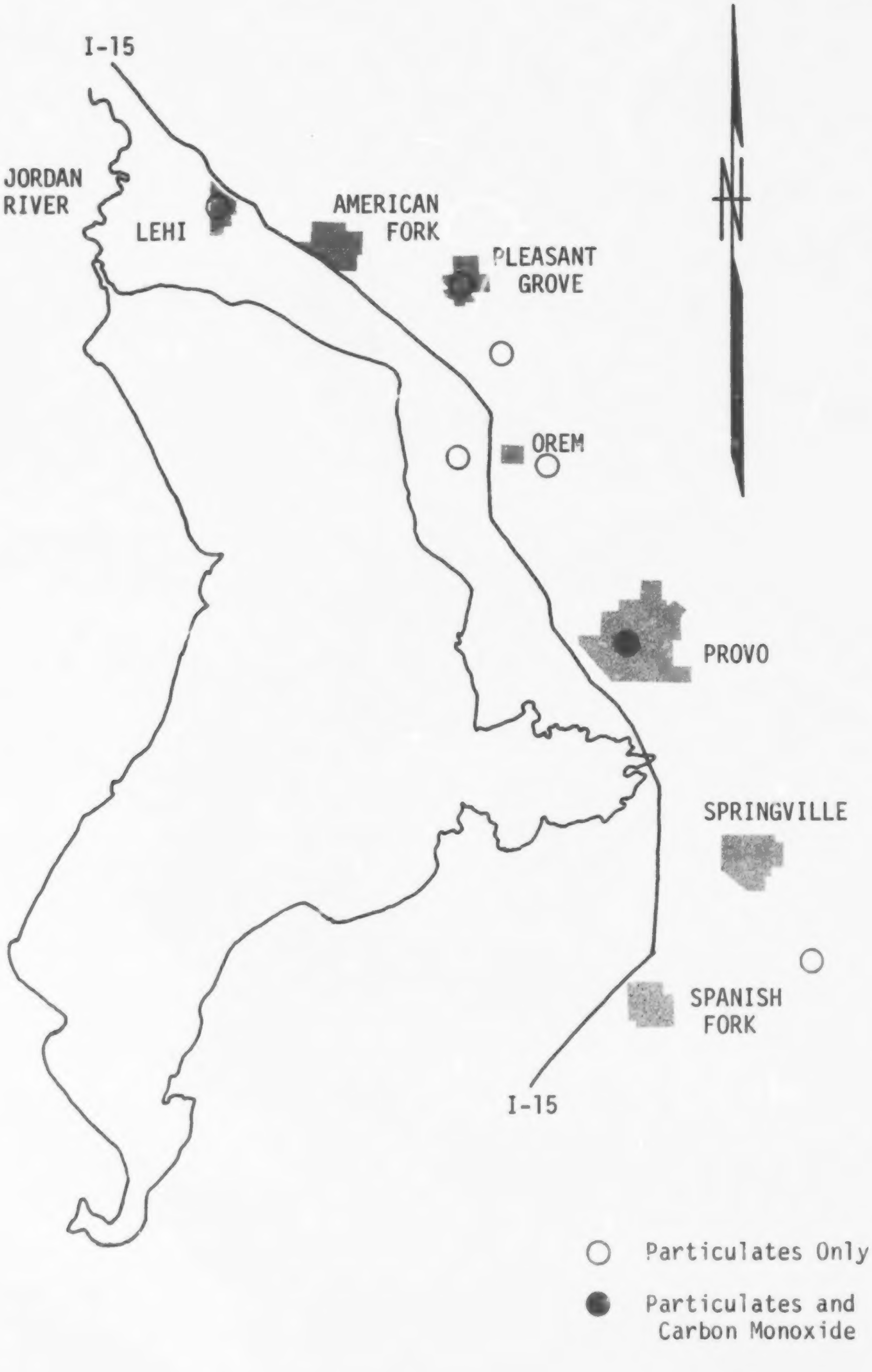

I-15
JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
OREM
PROVO
SPRINGVILLE
SPANISH FORK
I-15
N
○ Particulates Only
● Particulates and Carbon Monoxide

FIGURE II-28

AIR POLLUTANT MONITORING STATIONS

PROVO

All 13 stations are used to obtain daily averages of particulate concentrations in units of micrograms per cubic meter. High-volume air samplers are employed to collect fairly large quantities of particulate matter on filters. The total weight of particulate matter deposited each day is determined gravimetrically following EPA standard methods. Records of particulate concentrations extend at least back through 1974 for all stations.

Carbon monoxide concentration data are available from five stations in the two air basins. Data from these stations are reported in terms of hourly concentrations expressed as parts of pollutant per million parts of air (ppm).

Salt Lake City Basin - Significant historic carbon monoxide (CO) concentration data in the Salt Lake City basin are available only at the Salt Lake City station (Figure II-27). The Bountiful station had recorded CO data for two months. Maximum and second maximum (value exceeded only once/year) 1-hour and 8-hour CO concentrations for the period of record (1970-1974) are illustrated in Figure II-29. It appears from the data presented in Figure II-29 that decreases in maximum CO concentrations are being realized in Salt Lake City since 1972. The 1-hour second maximum primary standard of 35 ppm has been achieved since 1972, but the 8-hour second maximum primary standard of 9 ppm is still being violated. The second maximum one hour CO concentration for 1974 was 34 ppm which was recorded on January 11, 1974, at 9:00 A.M. The second maximum eight hour CO average for 1974 was 13 ppm which was recorded on January 11, 1974, at 10:00 A.M.

Historic, total suspended particulate (TSP) concentrations are available for six monitoring stations in the Salt Lake City basin; however, data for the Ogden sampling site is not included in this discussion because it is outside the Study Area. TSP values at the five remaining sites for 1974, including the measured geometric mean, the 24 hour maximum average, and the 24 hour second maximum average (value exceeded only once per year), are presented in Table II-4. In comparing the actual annual geometric mean values with the primary EPA standard of 75 micrograms per cubic meter (ug/m^3) only Kearns and Bountiful stations have acceptable annual average particulate concentrations. Considering the secondary standard of 60 ug/m^3, it is apparent that again only the Kearns and Bountiful stations are below the annual average standard. All the stations have recorded TSP concentrations above the primary and secondary 24 hour standards of 260 ug/m^3 and 150 ug/m^3, respectively, for both the maximum 24 hour average and for the second maximum 24 hour average.

Historic annual average TSP concentrations in the Salt Lake City basin for the period 1940 through 1971 are illustrated in Figure II-30. This historic data base reflects decreasing TSP concentrations at the Salt Lake City monitoring station but with annual geometric mean values still above the primary standard of 75 ug/m^3. In contrast, data from the Kearns and Magna sites manifest a reasonably constant historic annual TSP average concentration below the primary standard.

FIGURE II-29

AVERAGE HOURLY MAXIMUM CARBON MONOXIDE

SALT LAKE CITY AIR BASIN

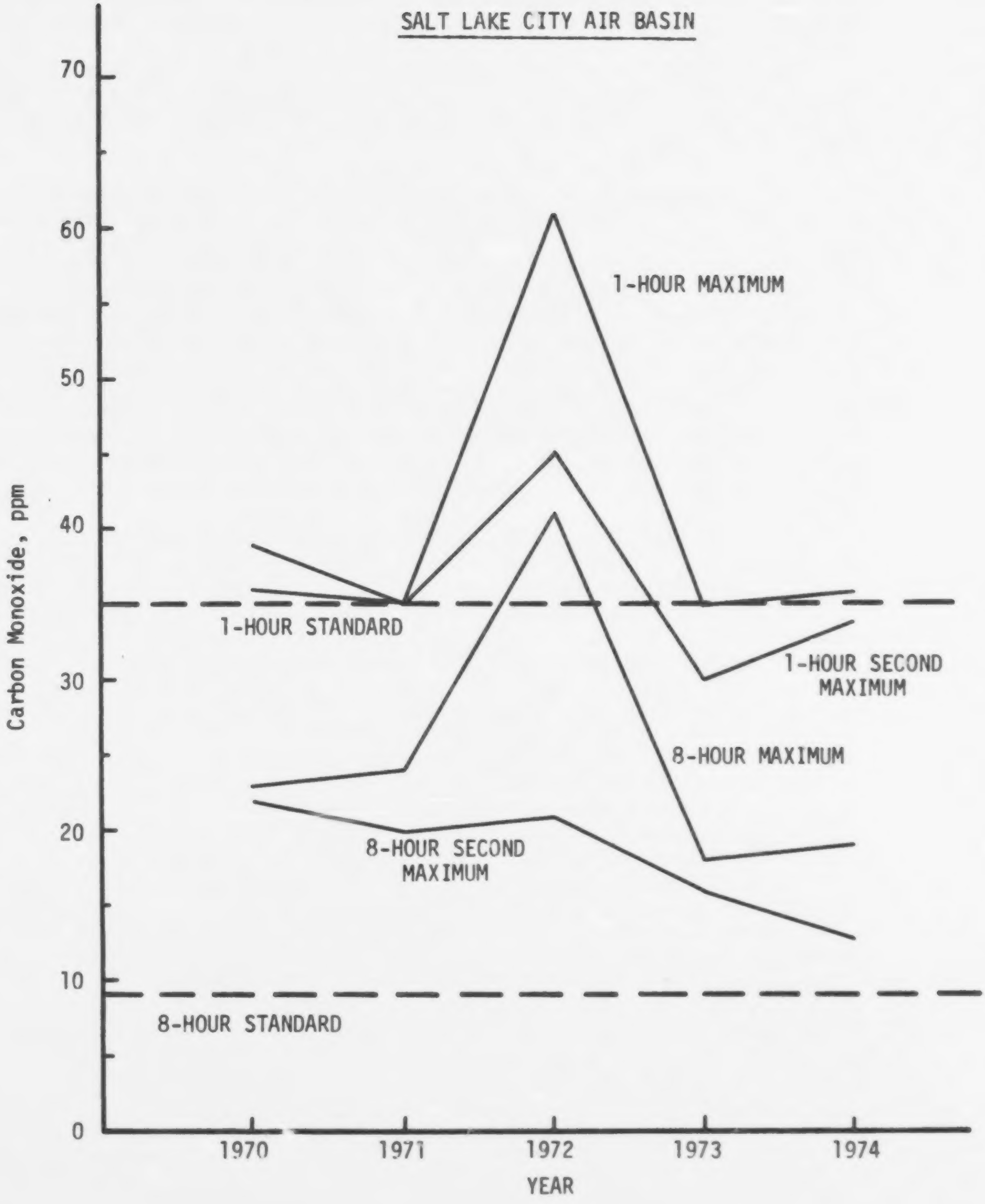


TABLE II-4

PARTICULATE CONCENTRATIONS IN THE SALT LAKE CITY BASIN (ug/m^3)
1974

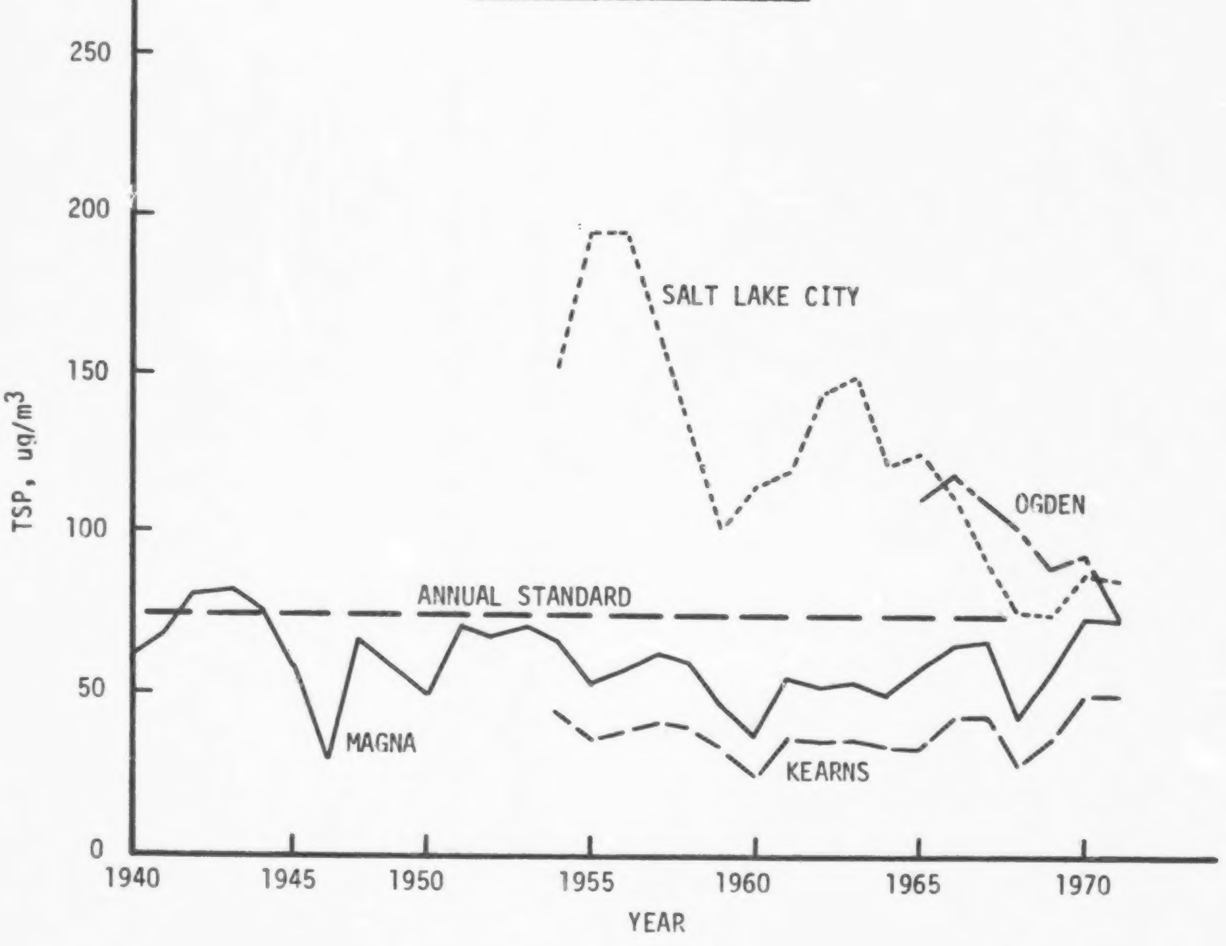
Monitoring Station	Annual Geo Mean	24-Hour Maximum Average	24-Hour Second Maximum Average
Salt Lake City	83[1]	637	542[2]
Salt Lake City International Airport	76[1]	702	456[2]
Magna	75	2,990	550[2]
Kearns	52	475	424[2]
Bountiful	49	476	---

1. Concentration violates the TSP primary annual standard of 75 ug/m^3.
2. Concentration violates the TSP primary 24-hour standard of 260 ug/m^3.

FIGURE II-30

ANNUAL AVERAGE TOTAL SUSPENDED PARTICULATES

SALT LAKE CITY AIR BASIN



Provo Basin - Carbon monoxide (CO) concentrations are available at only one station in the Provo basin, in downtown Provo (see Figure II-28). Historic CO concentrations at this site are illustrated in Figure II-31. Although the 1-hour maximum CO values have decreased between 1971 and 1973 and then increased slightly, the 1-hour second maximum CO concentrations have been below the primary standard of 35 ppm. Maximum and second maximum 8-hour CO concentrations reflect trends similar to the 1-hour values, but all of these 8-hour CO concentrations are above the primary standard of 9 ppm.

In 1974 the recorded maximum one-hour average of 30 ppm occurred on November 12, 1974 at 10:00 P.M. The second maximum one hour average in 1974 also was 30 ppm and was recorded on September 26, 1974 at 11:00 P.M. and October 18, 1974 at 9:00 A.M. The maximum eight hour average in 1974 was 18 ppm, recorded on November 13, 1974 at 3:00 A.M. The second maximum eight hour average in 1974 was 15 ppm and was recorded on September 27, 1974 at 2:00 A.M. and November 15, 1974 at 4:00 A.M.

Historic total suspended particulate (TSP) concentrations in the Provo basin are available for seven monitoring stations. TSP values at these sites for 1974 including the measured geometric mean, the 24-hour maximum average, and the 24-hour second maximum average (value exceeded only once per year) are presented in Table II-5. From the data in Table II-5, it is apparent that only the Provo site violates the primary annual average standard of 75 ug/m^3. With respect to the secondary annual average standard of 60 ug/m^3, Mapleton and Lehi are below it, and all other sites have recorded values above it.

All sites, except Orem, are in violation of the primary 24-hour standard of 260 ug/m^3 and all sites violate the secondary 24-hour standard for 150 ug/m^3.

Historic TSP records at Provo are available for 1972-1974 and for 1973-1974 for all other sites. These data are insufficient for establishing trends, but do not reflect any great variations at each site for the period of record.

Utah State Implementation Plan

The Air Quality Control Plan of the State of Utah establishes three air quality control regions (AQCR). One of these, the Wasatch Front AQCR, contains most of the Study Area, including all of the region for which model computations were made (see Chapter VI). Both carbon monoxide and total suspended particulates are classified as Priority I pollutants for the Wasatch Front AQCR, and a control strategy was established to achieve national secondary standards for particulates within three years after approval of the plan, and to attain national ambient air quality standards for carbon monoxide by 1977. Essential elements of these strategies are summarized below.

Carbon Monoxide (CO) - The State Implementation Plan (SIP) carbon-monoxide control strategy centers upon emissions from automobiles and

FIGURE II-31

AVERAGE HOURLY MAXIMUMS
CARBON MONOXIDE

PROVO AIR BASIN

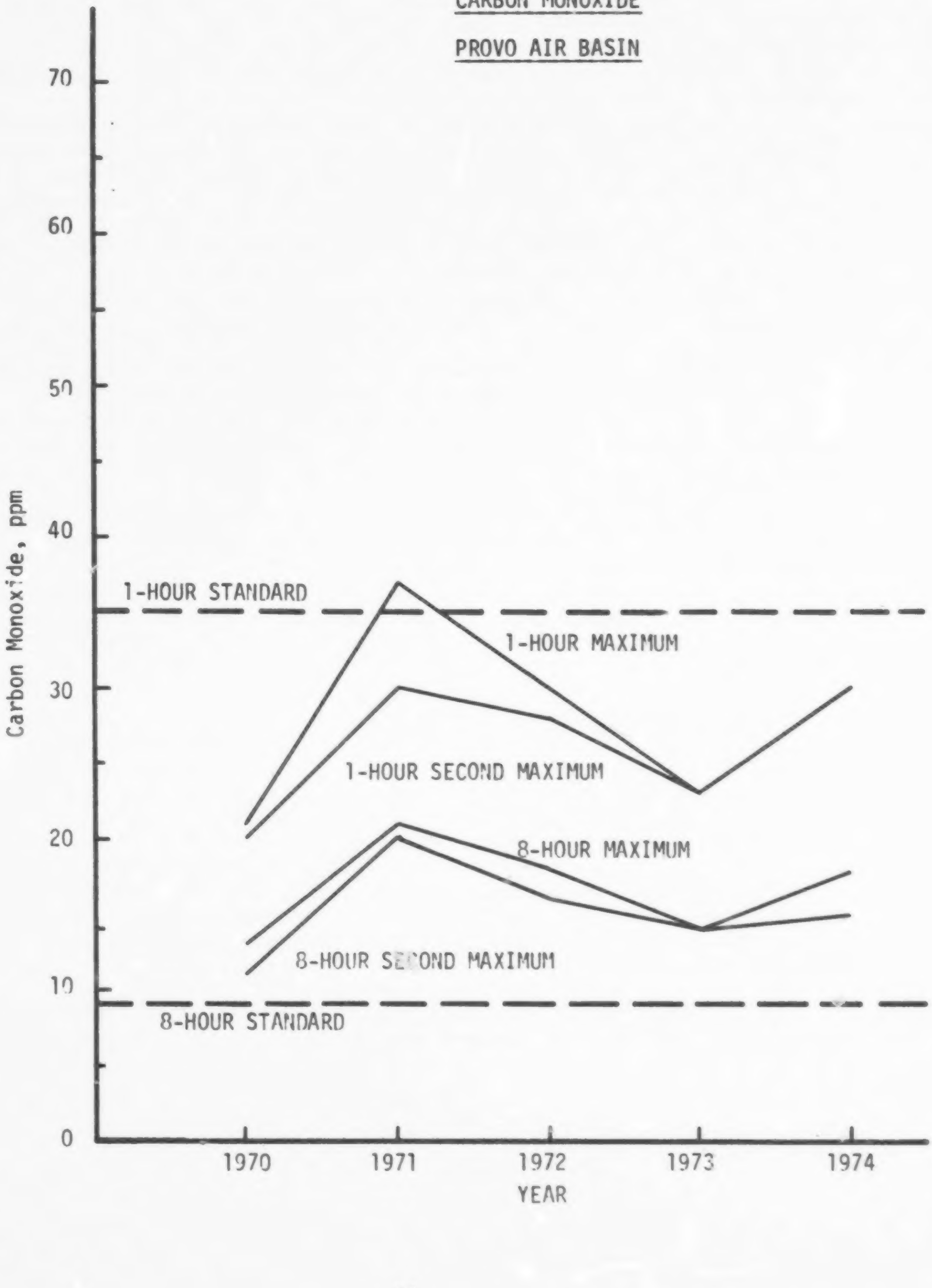


TABLE II-5

PARTICULATE CONCENTRATIONS IN THE PROVO BASIN (ug/m^3)
1974

Monitoring Site	Annual Geo Mean	24-Hour Maximum Average	24-Hour Second Maximum Average
Provo	78[1]	625	565[2]
Geneva	64	396	340[2]
Lehi	58	386	271[2]
Pleasant Grove	61	554	409[2]
Lindon	68	466	442[2]
Orem	70	226	202
Mapleton	44	441	305[2]

1. Concentration violates the TSP primary annual standard of 75 ug/m^3.
2. Concentration violates the TSP primary 24-hour standard of 260 ug/m^3.

light trucks, which reportedly account for approximately 96 percent of all CO emissions in Salt Lake County in 1970. The Initial Control Strategy includes: (1) enforcement of regulations pertaining to Notice of Construction, Open Burning, Visible Emissions, and Automobile Emission Control Devices; (2) enforcement of compliance with any pertinent future regulations; and (3) a public relations campaign designed to result in proper tuning of automobiles, widespread use of car pools or mass transit, and decreased use of automobiles. A supplemental control strategy provides for an annual inspection and maintenance program, a proposed intake manifold air-bleed device retrofit for pre-1968 model light-duty vehicles, and several detailed traffic control measures for both Salt Lake City and Provo (including continuous attention to mass transit improvements in both locations). The projected combined impact of these measures for Salt Lake County is presented in Table II-6.

Total Suspended Particulates (TSP) - The SIP control strategy for man-made particulates is built around a finding that particulate emissions from industrial processes and electric power generation accounted for approximately 90 percent of all particulate emissions in Utah County in 1970, and about 80 percent of the particulate emissions throughout the State. Thus, the strategy involves enforcement of standards related to emissions from stationary sources. Automotive vehicles, solid waste, and space heating are not considered applicable as subjects for emission reduction.

The control strategy includes enforcement of Code of Air Conservation Regulations pertaining to Notice of Construction, Open Burning, Visible Emissions, and Particulate Emissions. The strategy also includes enforcement of the applicable requirements of the Federal Standards of Performance for New Stationary Sources.

Expected results of the control strategy for Utah County, which contains the monitoring station (USDH-AQS Provo) manifesting the State's highest annual geometric mean TSP concentration in 1970, are presented in Table II-7. A background concentration of 20 micrograms per cubic meter was used for development of the strategy, and proportional models were used to demonstrate the adequacy of the control strategy.

One difficulty with the SIP is that only the emissions from point sources are controlled. Although these emissions represent a proportion of "man made" emissions in Utah County, they exclude important sources of TSP which contribute heavily to ambient concentrations throughout the Study Area. Because of the lack of precise data for individual point sources, the effect that the SIP controls will have on ambient concentrations could not be predicted in this EIS. The problem and its implications are discussed in Chapter IX.

TABLE II-6

CARBON MONOXIDE EMISSIONS ESTIMATES AND PROJECTION-TONS PER YEAR SALT LAKE COUNTY

Emissions Sources Category	Calendar Year 1970	1975	1977	1980
Autos & Light Trucks	217,278	158,613	117,330	67,356
Other Transportation	6,604	7,979	8,520	9,313
Solid Waste	1,249	1,350	1,393	1,453
Space Heating	767	828	854	890
Industrial Processes	152	172	192	208
Electric Power Generation	60	64	64	65
Total CO Emissions	226,110	169,006	128,353	79,285
% Reduction from 1970		25%	43%	65%

TABLE II-7

PARTICULATE EMISSIONS ESTIMATES AND PROJECTIONS - TONS PER YEAR UTAH COUNTY

	Emissions Sources Category	Calendar Year			
		1970	1975	1977	1980
Non-Applicable	Autos & Light Trucks	239	309	309	309
	Other Transportation	220	265	283	309
	Solid Waste	124	134	138	144
	Space Heating	393	425	439	457
	Subtotal (Non-Applicable)	976	1,133	1,169	1,219
Applicable	Space Heating	287	233	240	250
	Industrial Processes (Includes fuel combustion)	7,682	4,451	4,591	4,818
	Electric Power Gen.	886	298	310	328
	Subtotal (Applicable)	8,855	4,982	5,141	5,396
	Total Particulate Emissions	9,831	6,151	6,310	6,615
	% Reduction from 1970		37%	36%	33%

CHAPTER III

PROJECT ALTERNATIVES

LAND USE BASIS

Projected land use and population comprise the traditional data base for the development of water quality management alternatives. Available land use projections and population forecasts for various sectors of the Study Area were used in the development of the Utah Lake-Jordan River Basin Plan. Details of this information base are given in the Plan.

In order to facilitate the presentation of this data and the evaluation of environmental impacts, the Study Area was divided into sub-areas or planning areas as illustrated in Figure III-1. The following discussion relates to these planning areas.

Population

Study Area population is presented in Table III-1. The total 1970 population in the Study Area is reported to be 726,488 persons. The most significant portion of this population is in the Salt Lake City and South Salt Lake Areas which have 24.1 percent and 20.3 percent of the total Study Area 1970 population, respectively. Other densely populated areas include the North Davis Area with 8.1 percent of the 1970 Study Area population, the Murray-Cottonwood Area with 10.3 percent of the 1970 Study Area population, and the Provo Area with 8.2 percent of the 1970 Study Area population.

The projected 1995 Study Area population is estimated to be 1,304,557 persons. In general, the more populated areas of the Study Area are expected to develop with population spreading outward into the suburbs and close-in rural areas. The most significant population growth areas are expected to be the North Davis Area, the Central Davis Area, the Murray-Cottonwood Area, and the Tri-Community/Sandy Area. These areas are expected to realize 1995 populations of 118 percent, 241 percent, 130 percent, and 126 percent over 1970 populations, respectively. Slow growth areas include the Salt Lake City (39 percent population growth), the Lake Mountains (15 percent), and Goshen/Nephi Area (25 percent).

Land Use

Generalized existing land use is illustrated in Figure III-2 and future land use in Figure III-3. The growth potential within the two basins is illustrated by comparing the Figures. Existing development is centered in the Salt Lake and Utah Valleys and is surrounded by agriculture. Pockets of industrial development serve the urban areas. Greater recreational use of the canyons is also projected.

As forecasted, future development will spread in a north-south direction, connecting the two basins. Industrial development will expand concurrently. Perhaps the most environmentally significant aspect of future land use is the predicted development of canyon lands for recreational uses.

Existing and projected land use acreages are presented in Tables III-2 and III-3, respectively. A significant portion (68.6 percent)

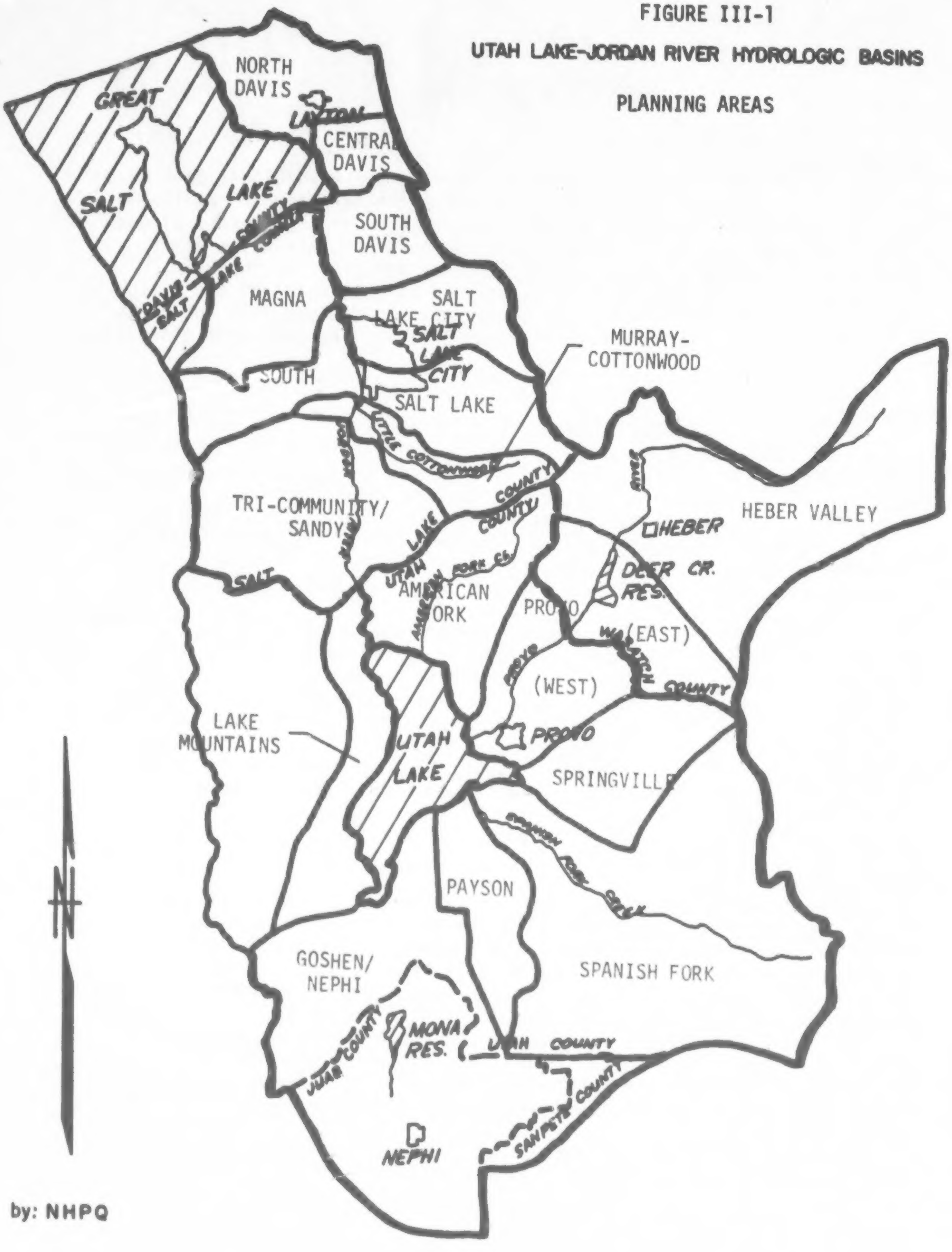

GREAT SALT LAKE
NORTH DAVIS
LAYTON
CENTRAL DAVIS
DAVIS COUNTY
SALT LAKE COUNTY
SOUTH DAVIS
MAGNA
SALT LAKE CITY
SALT LAKE CITY
SOUTH
SALT LAKE
MURRAY-COTTONWOOD
LITTLE COTTONWOOD
JORDAN
TRI-COMMUNITY/SANDY
SALT
SALT LAKE COUNTY
UTAH COUNTY
AMERICAN FORK CR.
AMERICAN FORK
HEBER
HEBER VALLEY
DEER CR. RES.
PROVO (EAST)
WASATCH COUNTY
PROVO
(WEST)
PROVO
LAKE MOUNTAINS
UTAH LAKE
SPRINGVILLE
SPANISH FORK CREEK
PAYSON
SPANISH FORK
GOSHEN/NEPHI
JUAB COUNTY
MONA RES.
UTAH COUNTY
SANPETE COUNTY
NEPHI
N

FIGURE III-1

UTAH LAKE-JORDAN RIVER HYDROLOGIC BASINS

PLANNING AREAS

by: NHPQ

TABLE III-1

EXISTING AND PROJECTED POPULATION

Planning Area	Population 1970	 1995
North Davis Area	58,632	127,800
Central Davis Area	9,518	32,500
South Davis Area	45,234	80,700
Magna Area	9,992	18,500
Salt Lake City	174,870	242,356
South Salt Lake Area	147,287	260,062
Murray-Cottonwood Area	74,816	172,207
Tri-Community/Sandy Area	51,642	116,882
American Fork Area	53,370	100,646
Heber Valley Area	5,863	9,820
Lake Mountains Area	295	340
Provo Area	59,826	86,415
Springville Area	12,160	21,730
Spanish Fork Area	9,001	14,752
Payson Area	8,120	12,536
Goshen/Nephi Area	5,862	7,311
TOTAL	726,488	1,304,557

FIGURE III-2

UTAH LAKE-JORDAN RIVER HYDROLOGIC BASINS

GENERALIZED EXISTING LAND USE

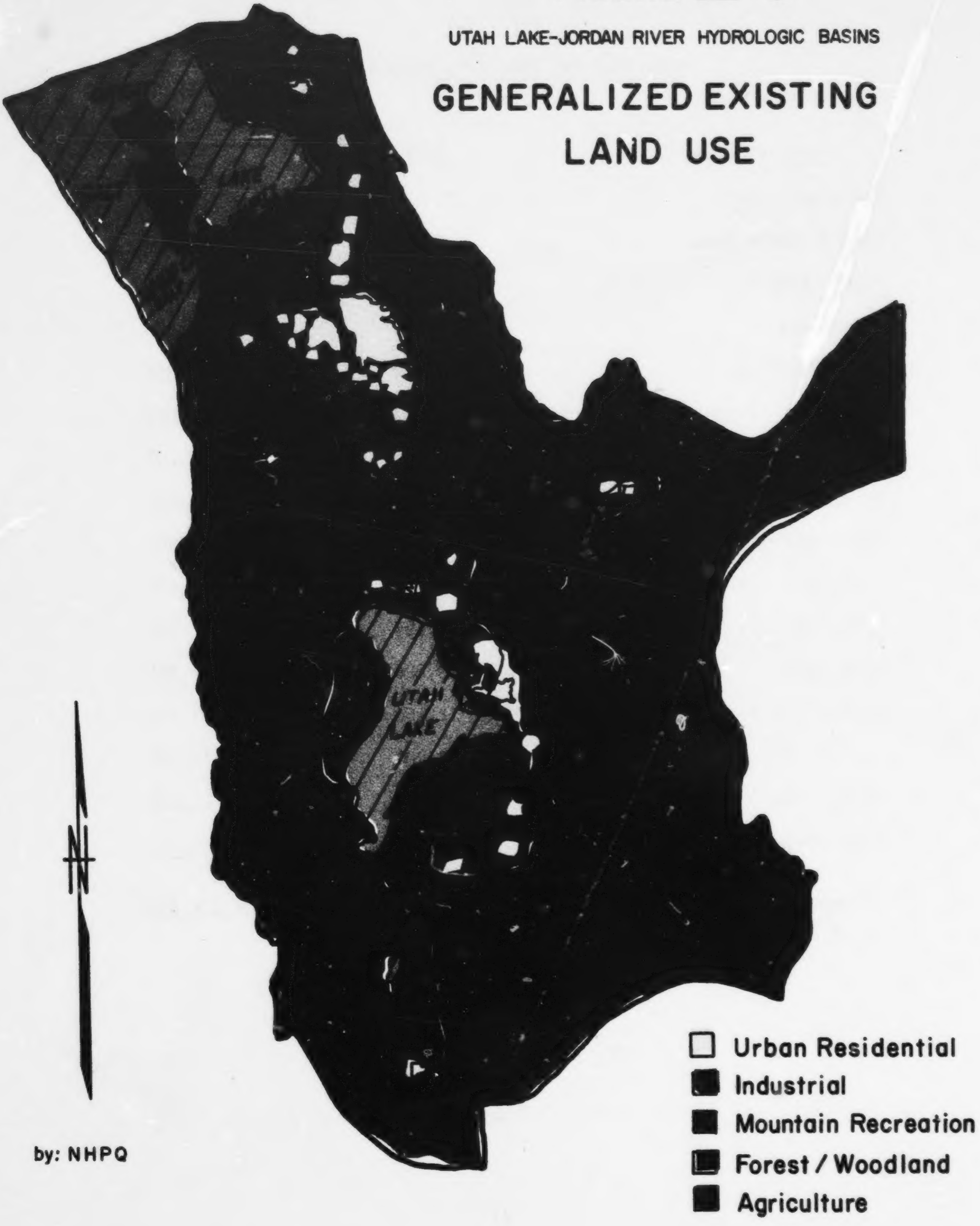
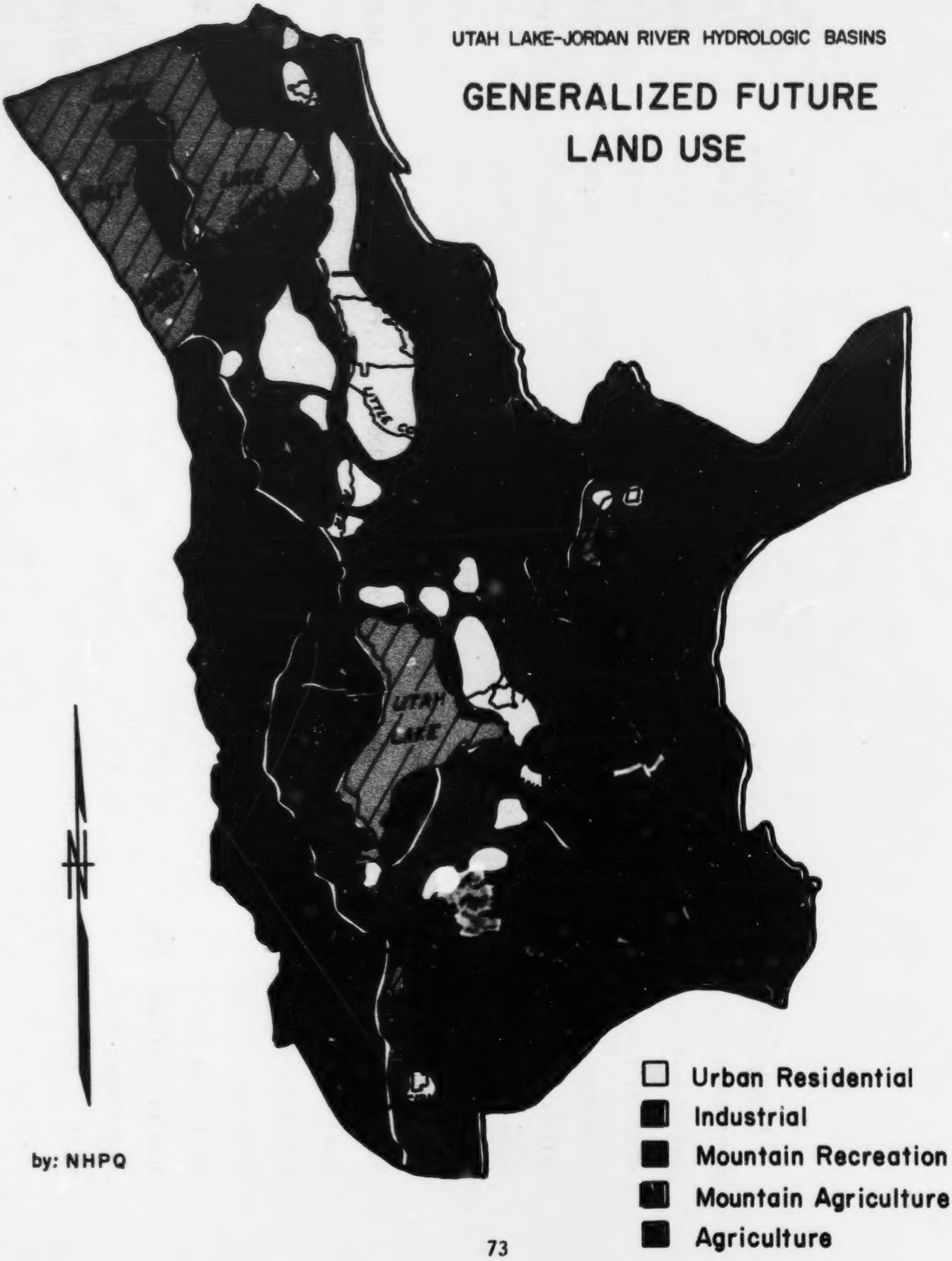

UTAH LAKE
N
☐ Urban Residential
■ Industrial
■ Mountain Recreation
■ Forest / Woodland
■ Agriculture
by: NHPQ

FIGURE III-3

UTAH LAKE-JORDAN RIVER HYDROLOGIC BASINS

GENERALIZED FUTURE LAND USE


UTAH LAKE
N
☐ Urban Residential
■ Industrial
■ Mountain Recreation
■ Mountain Agriculture
■ Agriculture

by: NHPQ

TABLE III-2

EXISTING LAND USES

Planning Area	Total Land Area (Acres)	Urban Land Area (Acres)	Agricultural Land Irrigated (Acres)	Agricultural Land Non-Irr. (Acres)	Vacant Land Area (Acres)	Silviculture Land Area (Acres)
North Davis Area	87,545	12,443	15,900	16,970	9,144	33,088
Central Davis Area	40,466	2,633	8,400	0	4,564	24,869
South Davis Area	62,069	5,480	12,100	0	11,283	33,206
Magna Area	73,701	12,245	1,900	5,425	26,564	27,567
Salt Lake City Area	97,304	22,695	1,200	0	18,922	54,487
South Salt Lake Area	128,323	18,878	11,000	4,744	9,152	84,549
Murray-Cottonwood Area	42,959	10,518	6,000	2,658	9,365	14,418
Tri-Community/Sandy Area	147,313	9,886	31,800	3,879	12,328	89,420
American Fork Area	135,806	12,022	34,300	7,993	20,644	60,847
Heber Valley Area	329,426	906	24,100	0	708	303,712
Lake Mountains Area	89,835	0	900	0	0	88,935
Provo Area	78,122	6,183	9,500	0	3,947	58,492
Springville Area	99,900	2,682	5,800	7,555	4,488	79,375
Spanish Fork/Payson Area	443,418	5,618	55,100	0	7,031	375,669
Goshen/Nephi Area	349,418	1,068	24,900	90,100	48,891	184,459
TOTAL	2,205,605	123,257	242,900	139,324	187,031	1,513,093

TABLE III-3

1995 LAND USES

Planning Area	Total Land Area (Acres)	Urban Land Area (Acres)	Agricultural Land		Vacant Land Area (Acres)	Silviculture Land Area (Acres)
			Irrigated (Acres)	Non-Irr. (Acres)		
North Davis Area	87,545	17,844	10,000	18,870	7,743	33,088
Central Davis Area	40,466	4,549	4,900	2,233	3,915	24,869
South Davis Area	62,069	8,769	7,400	0	12,694	33,206
Magna Area	73,701	13,992	1,500	4,700	25,942	27,567
Salt Lake City Area	97,304	25,854	800	0	16,163	54,487
South Salt Lake Area	128,323	33,763	6,300	2,311	1,400	84,549
Murray-Cottonwood Area	42,959	19,194	3,400	167	5,780	14,418
Tri-Community/Sandy Area	147,313	17,487	25,300	4,322	10,784	89,420
American Fork Area	135,806	16,655	31,500	6,978	19,826	60,847
Heber Valley Area	329,426	1,196	23,600	210	708	303,712
Lake Mountains Area	89,835	-	780	0	-	89,055
Provo Area	78,122	7,758	8,700	0	3,172	58,492
Springville Area	99,900	4,182	5,400	6,878	4,065	79,375
Spanish Fork/Payson Area	443,418	6,639	49,000	0	12,110	375,669
Goshen/Nephi Area	349,418	1,068	22,900	92,100	48,891	184,459
TOTAL	2,205,605	178,950	201,480	138,769	173,193	1,513,213

of the Study Area is currently covered with forests and woodlands. By comparison, urban development currently occupies only 5.6 percent of the total land area. The agricultural base of the Study Area is also evident with 17.3 percent of the land area in agriculture.

The Murray-Cottonwood Area is the most densely urbanized area with 24.5 percent of the land currently devoted to urban development. The Heber Valley Area and Goshen/Nephi Area are the least urbanized, 0.3 percent. Agricultural activity is greatest in the American Fork Area, Spanish Fork/Payson Area, and Goshen/Nephi Area.

The amount of Study Area land in forest and woodland is not expected to change significantly by 1995. Urban development is anticipated to increase to 8.1 percent of the total land area at the expense of agriculture and vacant land. By 1995, urbanization is expected to be centered in the North Davis Area, Salt Lake City Area, South Salt Lake Area, and Murray-Cottonwood Area with 20.4 percent, 26.6 percent, 26.3 percent, and 44.7 percent of total land devoted to future urban development, respectively. The Heber Valley Area and Goshen/Nephi Area will remain the least urbanized areas of the Study Area, 0.4 percent and 0.3 percent, respectively.

PLAN ALTERNATIVES

The development of physical system alternatives in the Plan was based on treatment levels as presented in Table III-4 and the following:

- publicly owned treatment facilities must receive secondary treatment by 1977 and best practicable treatment by 1983.
- Utah's interim effluent standards require a maximum of 10 mg/l BOD and 10 mg/l TSS in municipal wastewater effluents by 1980.
- minimum treatment requirements in 1980 will be Level III, but certain situations may require Level IV.
- economies of scale and efficiencies of design/operation can be achieved through regionalization or consolidation.
- alternatives include consideration of alternative treatment levels, varying degrees of consolidation, and relocation of discharges.
- the Study Area was divided into sub-areas and facility options developed for each sub-area.

Municipal Wastewater Management Alternatives - Davis County (DC)

Municipal wastewater management in Davis County is currently accomplished through four treatment plants: North Davis, Central Davis, South Davis North, and South Davis South. Future alternative wastewater management schemes are presented in Table III-5 and illustrated in Figure III-4.

A wide range of alternatives were considered. Expanding and upgrading all four facilities was the main theme of Alternatives 1 and 2. This plus constructing lake discharges at the North and Central Davis facilities was considered in Alternatives 3 and 4. Abandonment of the Central Davis facility and conveyance of wastewater to the North Davis facility was deliberated in Alternatives 5 and 6. Alternatives 7 and 8 focused on abandonment of the South Davis South facility and wastewater conveyance to the South Davis North plant while Alternatives 10 and 11 require conveyance to the Salt Lake City plant. Abandonment of both of the South

TABLE III-5

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - DAVIS COUNTY

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge to Great Salt Lake	Abandon/Connect To
DC-1	North Davis		X		
	Central Davis		X		
	South Davis North		X		
	South Davis South		X		
DC-2	North Davis	X			
	Central Davis	X			
	South Davis North	X			
	South Davis South	X			
DC-3	North Davis	X		X	
	Central Davis	X		X	
	South Davis North		X		
	South Davis South		X		
DC-4	North Davis	X		X	
	Central Davis	X		X	
	South Davis North	X			
	South Davis South	X			
DC-5	North Davis	X		X	
	Central Davis	→	→	→	North Davis
	South Davis North		X		
	South Davis South		X		
DC-6	North Davis	X			
	Central Davis	→	→	→	North Davis
	South Davis North	X			
	South Davis South	X			

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TABLE III-5 (Continued)

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - DAVIS COUNTY

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge to Great Salt Lake	Abandon/Connect To
DC-7	North Davis	X		X	
	Central Davis	X		X	
	South Davis North		X		
	South Davis South				→ South Davis North
DC-8	North Davis	X		X	
	Central Davis	X		X	
	South Davis North	X			
	South Davis South				→ South Davis North
DC-9	North Davis	X		X	
	Central Davis	X		X	
	South Davis North				→ Central Davis
	South Davis South				→ Central Davis
DC-10	North Davis	X		X	
	Central Davis	X		X	
	South Davis North		X		
	South Davis South				→ Salt Lake City (IV)
DC-11	North Davis	X		X	
	Central Davis	X		X	
	South Davis North	X			
	South Davis South				→ Salt Lake City (III)
DC-12	North Davis	X		X	
	Central Davis	X		X	
	South Davis North				→ Salt Lake City (IV)
	South Davis South				→ Salt Lake City (IV)

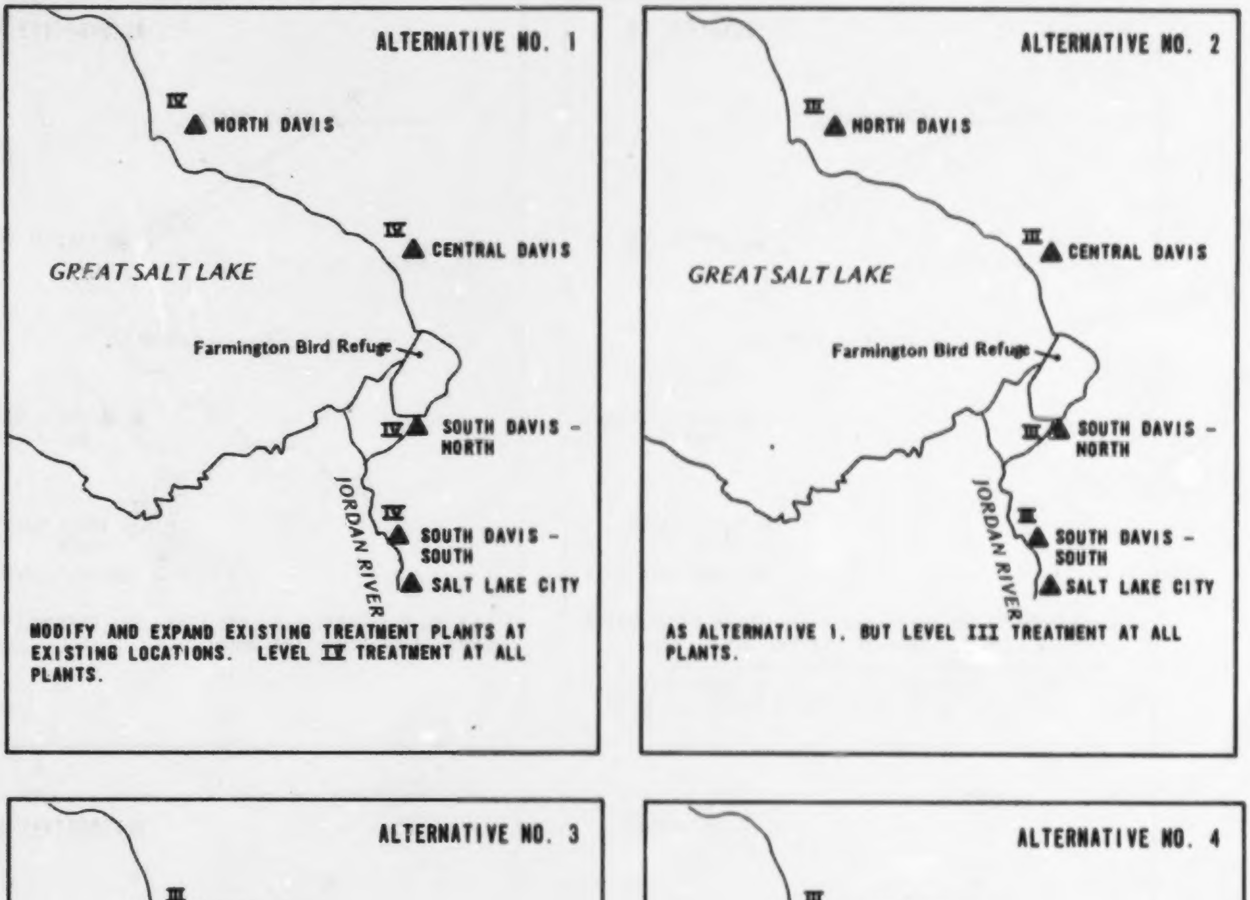
TABLE III-5 (Continued)

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - DAVIS COUNTY

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge to Great Salt Lake	Abandon/Connect To
DC-13	North Davis	X		X	
	Central Davis	X		X	
	South Davis North	→	→	→	Salt Lake City (III)
	South Davis South	→	→	→	Salt Lake City (III)
(A) Recommended Plan	North Davis	X			
	Central Davis	X			
	South Davis North	X			
	South Davis South	X			
(B) Recommended Plan	North Davis	X			
	Central Davis	X			
	South Davis North	X			
	South Davis South	→	→	→	South Davis North

FIGURE III-4

WASTEWATER TREATMENT ALTERNATIVES - DAVIS COUNTY


ALTERNATIVE NO. 1
IV
NORTH DAVIS
IV
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
IV
SOUTH DAVIS - NORTH
JORDAN RIVER
IV
SOUTH DAVIS - SOUTH
SALT LAKE CITY
ALTERNATIVE NO. 2
III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
III
SOUTH DAVIS - NORTH
JORDAN RIVER
III
SOUTH DAVIS - SOUTH
SALT LAKE CITY
ALTERNATIVE NO. 3
III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
IV
SOUTH DAVIS - NORTH
JORDAN RIVER
IV
SOUTH DAVIS - SOUTH
SALT LAKE CITY
ALTERNATIVE NO. 4
III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
III
SOUTH DAVIS - NORTH
JORDAN RIVER
III
SOUTH DAVIS - SOUTH
SALT LAKE CITY

ALTERNATIVE NO. 1: MODIFY AND EXPAND EXISTING TREATMENT PLANTS AT EXISTING LOCATIONS. LEVEL IV TREATMENT AT ALL PLANTS.

ALTERNATIVE NO. 2: AS ALTERNATIVE 1, BUT LEVEL III TREATMENT AT ALL PLANTS.

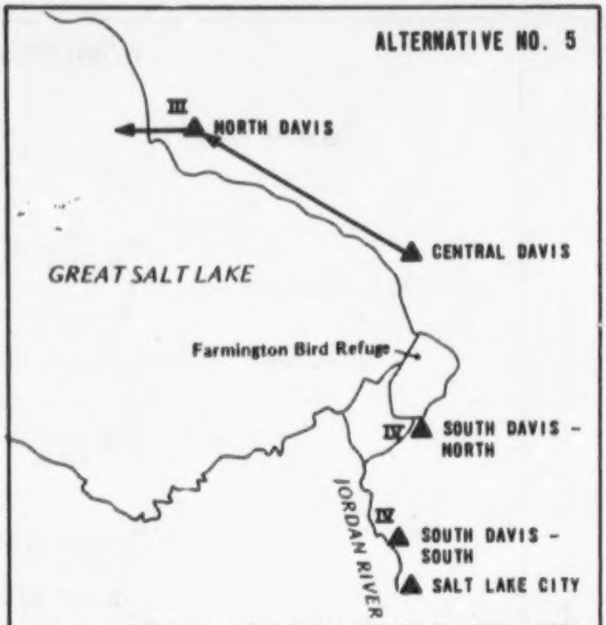
ALTERNATIVE NO. 3: MODIFY AND EXPAND EXISTING TREATMENT PLANTS AT EXISTING LOCATIONS. CONSTRUCT LAKE OUTFALLS AT NORTH AND CENTRAL DAVIS. LEVEL III TREATMENT AT NORTH AND CENTRAL DAVIS; LEVEL IV TREATMENT AT SOUTH DAVIS NORTH AND SOUTH.

ALTERNATIVE NO. 4: AS ALTERNATIVE 3, BUT LEVEL III TREATMENT AT SOUTH DAVIS NORTH AND SOUTH.

FIGURE III-4 (Continued)

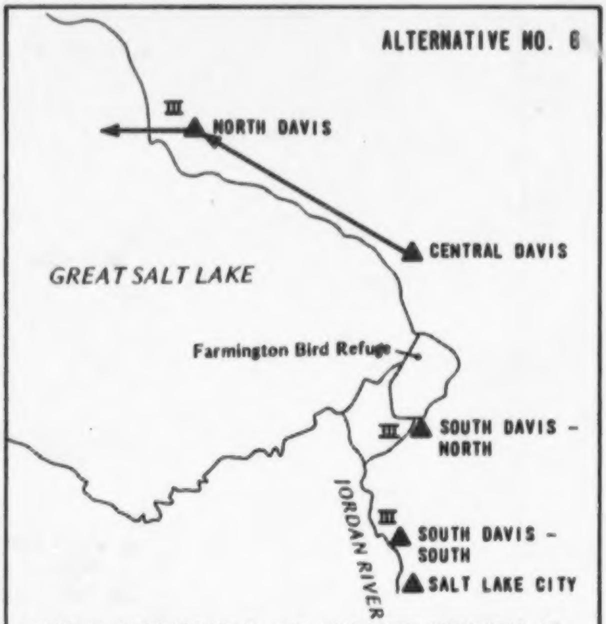
WASTEWATER TREATMENT ALTERNATIVES - DAVIS COUNTY

ALTERNATIVE NO. 5


III
NORTH DAVIS
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
IV
SOUTH DAVIS - NORTH
JORDAN RIVER
IV
SOUTH DAVIS - SOUTH
SALT LAKE CITY

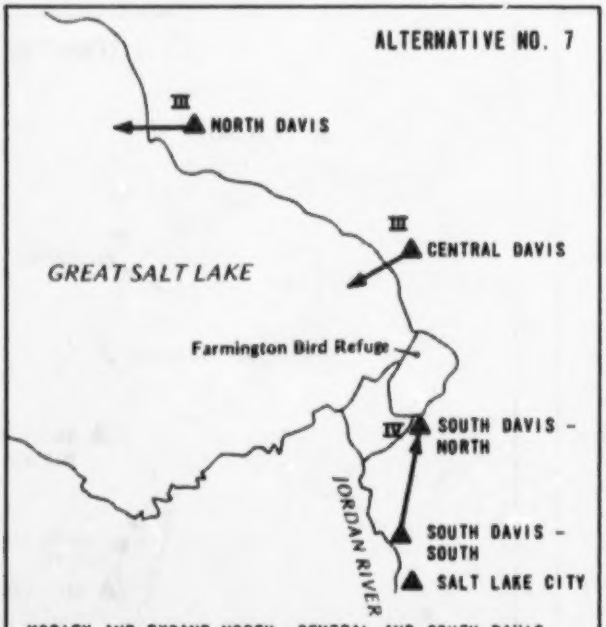
MODIFY AND EXPAND NORTH DAVIS AND SOUTH DAVIS NORTH AND SOUTH PLANTS. ABANDON CENTRAL DAVIS, CONVEY FLOWS TO NORTH DAVIS. CONSTRUCT LAKE OUTFALL AT NORTH DAVIS. TREATMENT LEVEL III AT NORTH DAVIS; TREATMENT LEVEL IV AT SOUTH DAVIS NORTH AND SOUTH.

ALTERNATIVE NO. 6


III
NORTH DAVIS
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
III
SOUTH DAVIS - NORTH
JORDAN RIVER
III
SOUTH DAVIS - SOUTH
SALT LAKE CITY

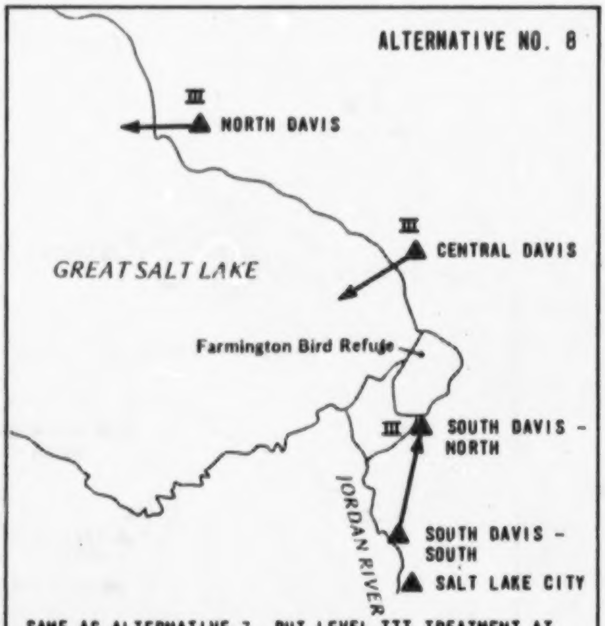
SAME AS ALTERNATIVE 5, BUT LEVEL III TREATMENT AT SOUTH DAVIS NORTH AND SOUTH.

ALTERNATIVE NO. 7


III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
IV
SOUTH DAVIS - NORTH
JORDAN RIVER
SOUTH DAVIS - SOUTH
SALT LAKE CITY

MODIFY AND EXPAND NORTH, CENTRAL AND SOUTH DAVIS NORTH. ABANDON SOUTH DAVIS SOUTH, CONVEY FLOWS TO SOUTH DAVIS NORTH. CONSTRUCT LAKE OUTFALLS AT NORTH AND CENTRAL DAVIS. TREATMENT LEVEL III AT NORTH AND CENTRAL DAVIS. TREATMENT LEVEL IV AT SOUTH DAVIS NORTH.

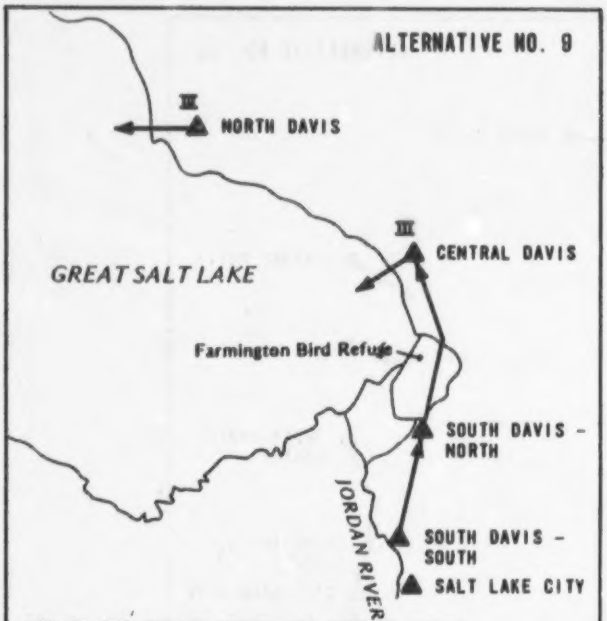
ALTERNATIVE NO. 8


III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
III
SOUTH DAVIS - NORTH
JORDAN RIVER
SOUTH DAVIS - SOUTH
SALT LAKE CITY

SAME AS ALTERNATIVE 7, BUT LEVEL III TREATMENT AT SOUTH DAVIS NORTH.

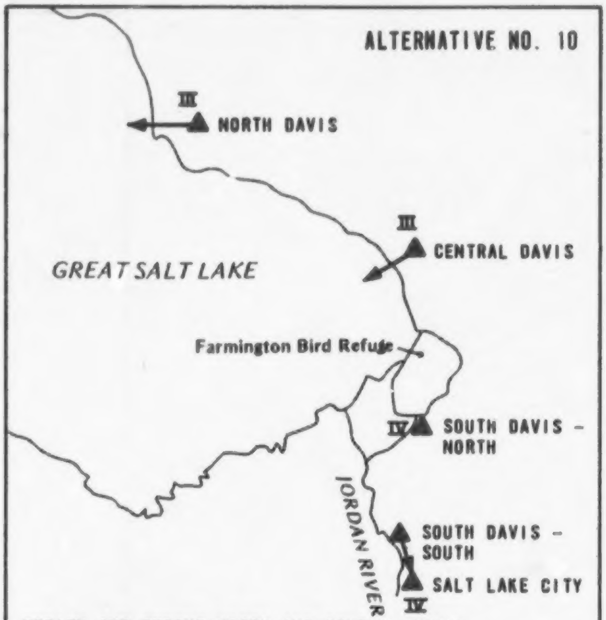
FIGURE III-4 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - DAVIS COUNTY


ALTERNATIVE NO. 9

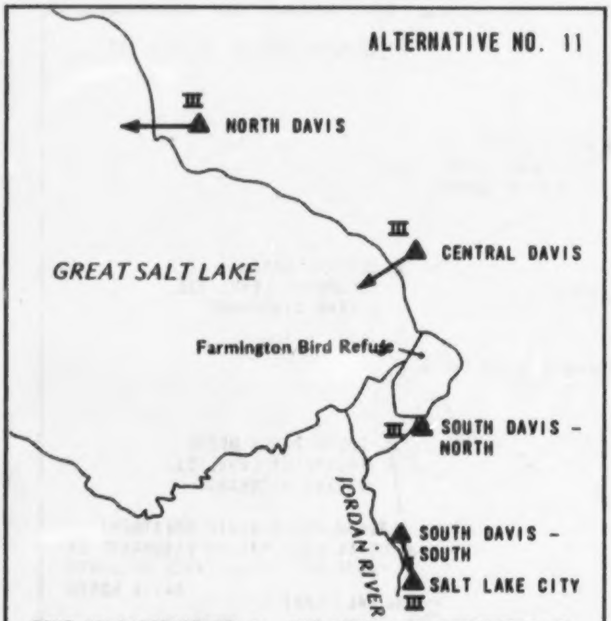
III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
SOUTH DAVIS - NORTH
JORDAN RIVER
SOUTH DAVIS - SOUTH
SALT LAKE CITY

MODIFY AND EXPAND NORTH AND CENTRAL DAVIS. CONSTRUCT LAKE OUTFALLS AT NORTH AND CENTRAL DAVIS. LEVEL III TREATMENT. ABANDON SOUTH DAVIS SOUTH AND SOUTH DAVIS NORTH. CONVEY FLOWS TO CENTRAL DAVIS.


ALTERNATIVE NO. 10

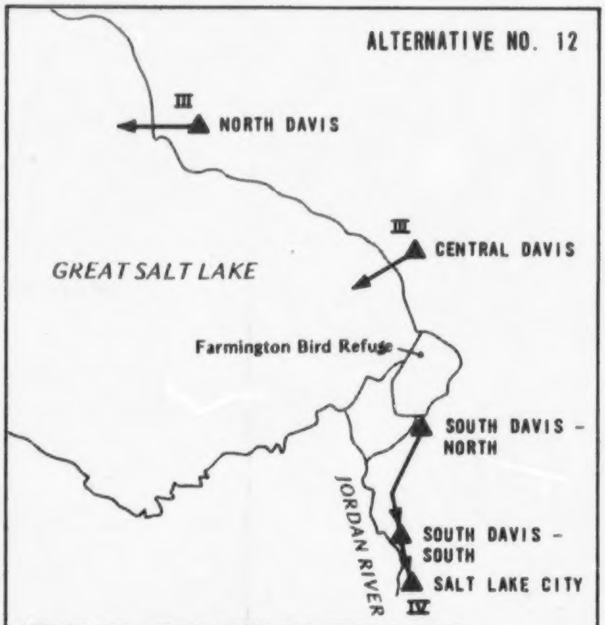
III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
IV
SOUTH DAVIS - NORTH
JORDAN RIVER
SOUTH DAVIS - SOUTH
SALT LAKE CITY
IV

MODIFY AND EXPAND NORTH AND CENTRAL DAVIS. CONSTRUCT LAKE OUTFALLS AT NORTH AND CENTRAL DAVIS. LEVEL III TREATMENT. LEVEL IV TREATMENT AT SOUTH DAVIS NORTH. ABANDON SOUTH DAVIS SOUTH. CONVEY FLOWS TO SALT LAKE CITY. TREATMENT LEVEL IV.


ALTERNATIVE NO. 11

III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
III
SOUTH DAVIS - NORTH
JORDAN RIVER
SOUTH DAVIS - SOUTH
SALT LAKE CITY
III

SAME AS ALTERNATIVE 10, BUT LEVEL III TREATMENT AT SOUTH DAVIS NORTH AND SALT LAKE CITY.

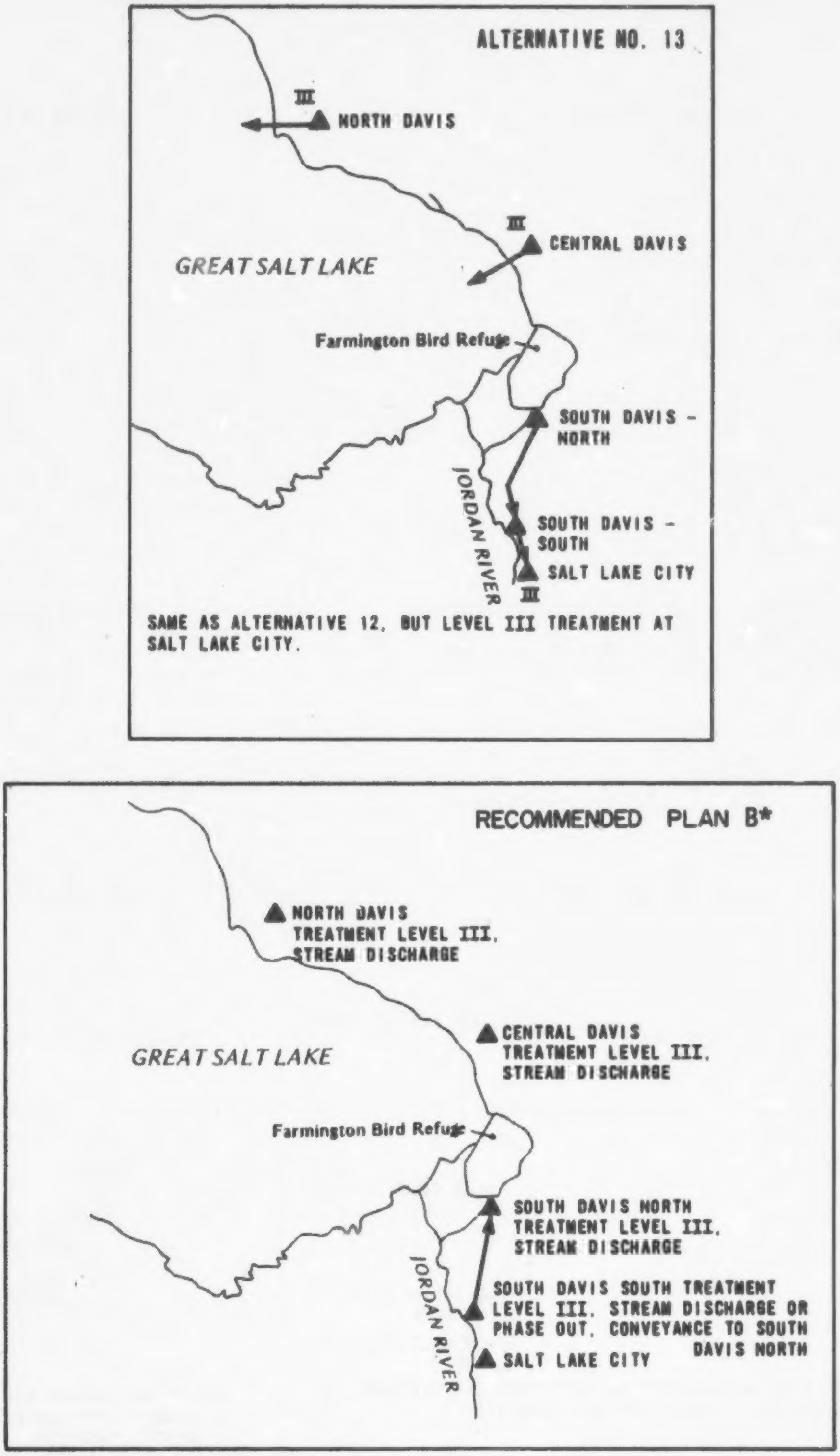

ALTERNATIVE NO. 12

III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
SOUTH DAVIS - NORTH
JORDAN RIVER
SOUTH DAVIS - SOUTH
SALT LAKE CITY
IV

MODIFY AND EXPAND NORTH AND CENTRAL DAVIS. CONSTRUCT LAKE OUTFALLS AT NORTH AND CENTRAL DAVIS. LEVEL III TREATMENT. ABANDON SOUTH DAVIS NORTH AND SOUTH DAVIS SOUTH. CONVEY FLOWS TO SALT LAKE CITY. TREATMENT LEVEL IV.

FIGURE III-4 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - DAVIS COUNTY


ALTERNATIVE NO. 13
III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
SOUTH DAVIS - NORTH
JORDAN RIVER
SOUTH DAVIS - SOUTH
SALT LAKE CITY
III
RECOMMENDED PLAN B*
NORTH DAVIS
TREATMENT LEVEL III,
STREAM DISCHARGE
CENTRAL DAVIS
TREATMENT LEVEL III,
STREAM DISCHARGE
GREAT SALT LAKE
Farmington Bird Refuge
SOUTH DAVIS NORTH
TREATMENT LEVEL III,
STREAM DISCHARGE
SOUTH DAVIS SOUTH TREATMENT
LEVEL III, STREAM DISCHARGE OR
PHASE OUT, CONVEYANCE TO SOUTH
DAVIS NORTH
JORDAN RIVER
SALT LAKE CITY

SAME AS ALTERNATIVE 12, BUT LEVEL III TREATMENT AT SALT LAKE CITY.

*RECOMMENDED PLAN A IS SHOWN AS ALTERNATIVE DC-2

Davis facilities was considered in Alternatives 9, 12, and 13. In Alternative 9, wastewater would be conveyed to the Central Davis plant and in Alternatives 12 and 13 to the Salt Lake City plant.

Two alternative recommended plans are suggested; maintaining all four facilities at Level III (same as Alternative 2) or phasing out South Davis South and connecting it to South Davis North. The decision as to the best course of action is presently being investigated by the ongoing 208 programs.

Municipal Wastewater Management Alternatives - Salt Lake County (SLC)

For the purposes of this report, wastewater management in Salt Lake County has been divided into two areas. Wastewater in the Magna area is treated at the Magna facility and is discharged to Kersey Creek and thus to Great Salt Lake. All other facilities either discharge to the Jordan River, have no discharge, or, in the case of Salt Lake City, discharge to the Lake through a sewage canal. Thus, the Magna facility is discussed separately in the next section. This section contains a discussion of all those facilities in the Salt Lake Valley.

Currently, approximately one-half of the wastewaters generated in the Salt Lake Valley are treated at the Salt Lake City Treatment Plant and are subsequently discharged to the Salt Lake City Sewage Canal which flows to Great Salt Lake. The remaining half is treated at the Sandy City, Tri-Community, Murray City, Salt Lake County-Cottonwood, Granger-Hunter, Salt Lake City, Suburban Sanitation District No. 1, and South Salt Lake City facilities. These seven facilities discharge wastewater along a 14 mile reach of the Jordan River between 94th and 21st South. Future alternative wastewater management schemes for the area are presented in Table III-6 and illustrated in Figure III-5.

Utilization of existing treatment plant locations with upgrading and expansion is considered in Alternatives 1 and 2. Abandonment of Sandy City, Murray, Granger-Hunter, and South Salt Lake City is the theme of Alternatives 3 and 4. Alternatives 5 and 9 prescribe the abandonment of the Sandy, Murray, Cottonwood, Granger-Hunter, and South Salt Lake facilities. For these two alternatives, Sandy would be connected to Tri-Community and the remainder to Suburban Sanitation District No. 1. In Alternatives 6, 10, and 12, all facilities except Suburban Sanitation District No. 1 and Salt Lake City would be abandoned and connected to Suburban Sanitation District No. 1. Alternative 12 requires a discharge to Great Salt Lake at Salt Lake City. Alternatives 7, 8, and 11 consider regionalization at Salt Lake City with Alternative 8 requiring a discharge to Great Salt Lake.

The recommended plan is similar to Alternative 10, but includes the abandonment of the Camp Williams and State Prison facilities and connection to Suburban Sanitation District No. 1. An interceptor connecting these two facilities to Tri-Community has already been constructed. Additionally, interim upgrading is planned or is under construction at Tri-Community, Granger-Hunter, and Murray.

Two communities not addressed in the above discussion, Lark and Copperton, presently discharge to non-discharging lagoons. Because

TABLE III-6

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - SALT LAKE COUNTY

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge to Great Salt Lake	Abandon/Connect To
SLC-1	Sandy City		X		
	Tri-Community		X		
	Murray City		X		
	Salt Lake County-Cottonwood		X		
	Granger-Hunter		X		
	Salt Lake City SSD No. 1		X		
	South Salt Lake City		X		
	Salt Lake City		X		
SLC-2	Sandy City	X			
	Tri-Community	X			
	Murray City	X			
	Salt Lake County-Cottonwood	X			
	Granger-Hunter	X			
	Salt Lake City SSD No. 1	X			
	South Salt Lake City	X			
	Salt Lake City	X			
SLC-3	Sandy City	→	→	→	Tri-Community
	Tri-Community		X		
	Murray City	→	→	→	Cottonwood
	Salt Lake County-Cottonwood		X		
	Granger-Hunter	→	→	→	Salt Lake City SSD-1
	Salt Lake City SSD No. 1		X		
	South Salt Lake City	→	→	→	Salt Lake City SSD-1
	Salt Lake City		X		

TABLE III-6 (Continued)

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - SALT LAKE COUNTY

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge to Great Salt Lake	Abandon/Connect To
SLC-4	Sandy City			→	Tri-Community
	Tri-Community	X			
	Murray City			→	Cottonwood
	Salt Lake County-Cottonwood	X			
	Granger-Hunter			→	Salt Lake City SSD-1
	Salt Lake City SSD No. 1	X			
	South Salt Lake City			→	Salt Lake City SSD-1
	Salt Lake City	X			
SLC-5	Sandy City			→	Tri-Community
	Tri-Community		X		
	Murray City			→	Salt Lake City SSD-1
	Salt Lake County-Cottonwood			→	Salt Lake City SSD-1
	Granger-Hunter			→	Salt Lake City SSD-1
	Salt Lake City SSD No. 1		X		
	South Salt Lake City			→	Salt Lake City SSD-1
	Salt Lake City		X		
SLC-6	Sandy City			→	Salt Lake City SSD-1
	Tri-Community			→	Salt Lake City SSD-1
	Murray City			→	Salt Lake City SSD-1
	Salt Lake County-Cottonwood			→	Salt Lake City SSD-1
	Granger-Hunter			→	Salt Lake City SSD-1
	Salt Lake City SSD No. 1		X		
	South Salt Lake City			→	Salt Lake City SSD-1
	Salt Lake City		X		

TABLE III-6 (Continued)

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - SALT LAKE COUNTY

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge to Great Salt Lake	Abandon/Connect To
SLC-7	Sandy City	→	→	→	Salt Lake City
	Tri-Community	→	→	→	Salt Lake City
	Murray City	→	→	→	Salt Lake City
	Salt Lake County-Cottonwood	→	→	→	Salt Lake City
	Granger-Hunter	→	→	→	Salt Lake City
	Salt Lake City SSD No. 1	→	→	→	Salt Lake City
	South Salt Lake City	→	→	→	Salt Lake City
	Salt Lake City		X		
SLC-8	Sandy City	→	→	→	Salt Lake City
	Tri-Community	→	→	→	Salt Lake City
	Murray City	→	→	→	Salt Lake City
	Salt Lake County-Cottonwood	→	→	→	Salt Lake City
	Granger-Hunter	→	→	→	Salt Lake City
	Salt Lake City SSD No. 1	→	→	→	Salt Lake City
	South Salt Lake City	→	→	→	Salt Lake City
	Salt Lake City	X		X	
SLC-9	Sandy City	→	→	→	Tri-Community
	Tri-Community	X			
	Murray City	→	→	→	Salt Lake City SSD-1
	Salt Lake County-Cottonwood	→	→	→	Salt Lake City SSD-1
	Granger-Hunter	→	→	→	Salt Lake City SSD-1
	Salt Lake City SSD No. 1	X			
	South Salt Lake City	→	→	→	Salt Lake City SSD-1
	Salt Lake City	X			

TABLE III-6 (Continued)

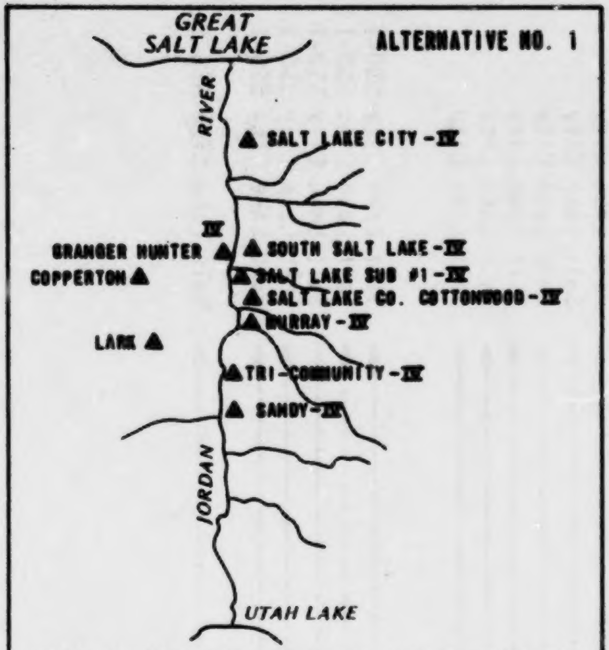
MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - SALT LAKE COUNTY

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge to Great Salt Lake	Abandon/Connect To
SLC-10*	Sandy City	→	→	→	Salt Lake City SSD-1
	Tri-Community	→	→	→	Salt Lake City SSD-1
	Murray City	→	→	→	Salt Lake City SSD-1
	Salt Lake County-Cottonwood	→	→	→	Salt Lake City SSD-1
	Granger-Hunter	→	→	→	Salt Lake City SSD-1
	Salt Lake City SSD No. 1	X			
	South Salt Lake City	→	→	→	Salt Lake City SSD-1
	Salt Lake City	X			
SLC-11	Sandy City	→	→	→	Salt Lake City
	Tri-Community	→	→	→	Salt Lake City
	Murray City	→	→	→	Salt Lake City
	Salt Lake County-Cottonwood	→	→	→	Salt Lake City
	Granger-Hunter	→	→	→	Salt Lake City
	Salt Lake City SSD No. 1	→	→	→	Salt Lake City
	South Salt Lake City	→	→	→	Salt Lake City
	Salt Lake City	X			
SLC-12	Sandy City	→	→	→	Salt Lake City SSD-1
	Tri-Community	→	→	→	Salt Lake City SSD-1
	Murray City	→	→	→	Salt Lake City SSD-1
	Salt Lake County-Cottonwood	→	→	→	Salt Lake City SSD-1
	Granger-Hunter	→	→	→	Salt Lake City SSD-1
	Salt Lake City SSD No. 1	X			
	South Salt Lake City	→	→	→	Salt Lake City SSD-1
	Salt Lake City	X		X	

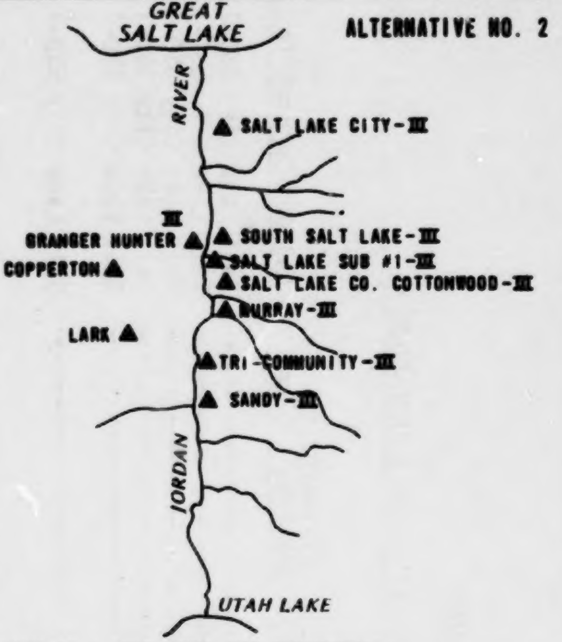
*Recommended Plan

FIGURE III-5

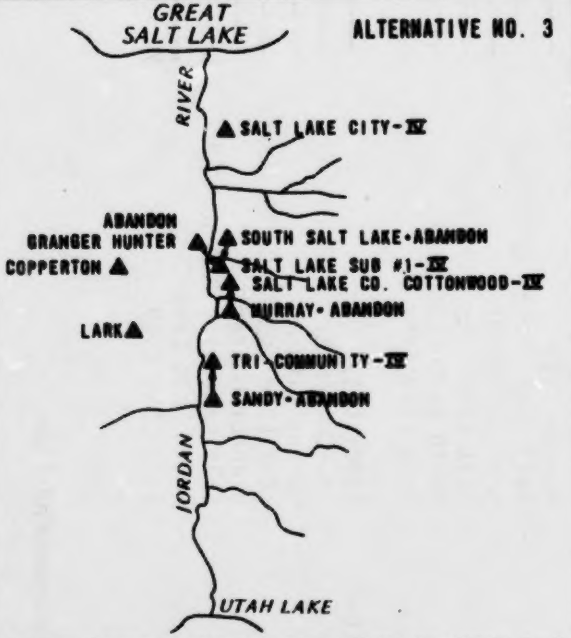
WASTEWATER TREATMENT ALTERNATIVES - SALT LAKE COUNTY


GREAT SALT LAKE
ALTERNATIVE NO. 1
RIVER
SALT LAKE CITY-IV
IV
GRANGER HUNTER
SOUTH SALT LAKE-IV
COPPERTON
SALT LAKE SUB #1-IV
SALT LAKE CO. COTTONWOOD-IV
MURRAY-IV
LARK
TRI-COMMUNITY-IV
SANDY-IV
JORDAN
UTAH LAKE

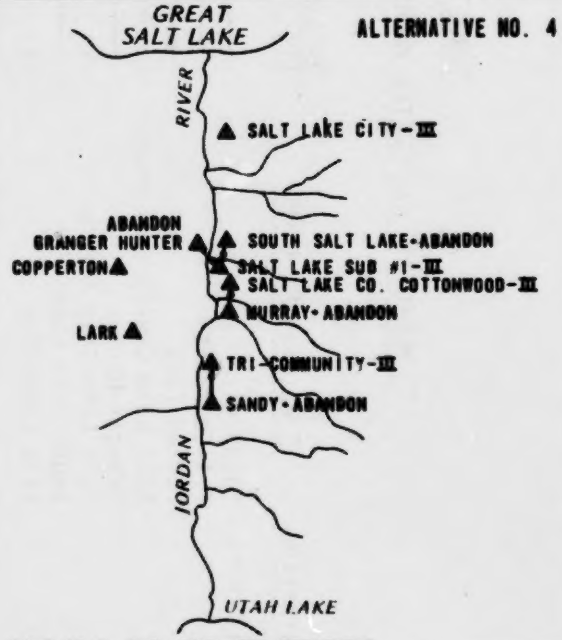
MODIFY AND EXPAND ALL EXISTING PLANTS AT EXISTING LOCATIONS.


GREAT SALT LAKE
ALTERNATIVE NO. 2
RIVER
SALT LAKE CITY-III
III
GRANGER HUNTER
SOUTH SALT LAKE-III
COPPERTON
SALT LAKE SUB #1-III
SALT LAKE CO. COTTONWOOD-III
MURRAY-III
LARK
TRI-COMMUNITY-III
SANDY-III
JORDAN
UTAH LAKE

SAME AS 1, BUT LEVEL III TREATMENT.......................


GREAT SALT LAKE
ALTERNATIVE NO. 3
RIVER
SALT LAKE CITY-IV
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-IV
SALT LAKE CO. COTTONWOOD-IV
MURRAY-ABANDON
LARK
TRI-COMMUNITY-IV
SANDY-ABANDON
JORDAN
UTAH LAKE

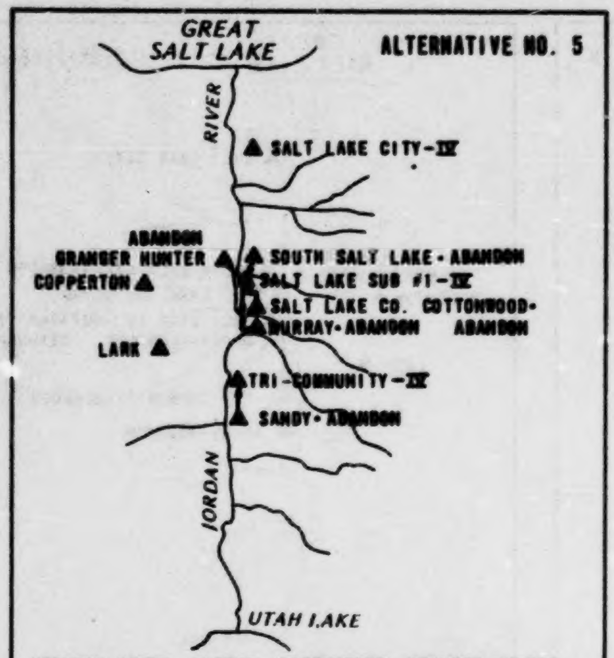
ABANDON SANDY, MURRAY, GRANGER-HUNTER AND SOUTH SALT LAKE PLANTS. CONVEY FLOWS FROM SANDY TO TRI-COMMUNITY, MURRAY TO COTTONWOOD AND FROM GRANGER-HUNTER AND SOUTH SALT LAKE TO SALT LAKE CITY SUBURBAN NO. 1. MODIFY AND EXPAND TRI-COMMUNITY, COTTONWOOD, SALT LAKE CITY SUBURBAN NO. 1 AND SALT LAKE CITY PLANTS. TREATMENT LEVEL IV.


GREAT SALT LAKE
ALTERNATIVE NO. 4
RIVER
SALT LAKE CITY-III
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-III
SALT LAKE CO. COTTONWOOD-III
MURRAY-ABANDON
LARK
TRI-COMMUNITY-III
SANDY-ABANDON
JORDAN
UTAH LAKE

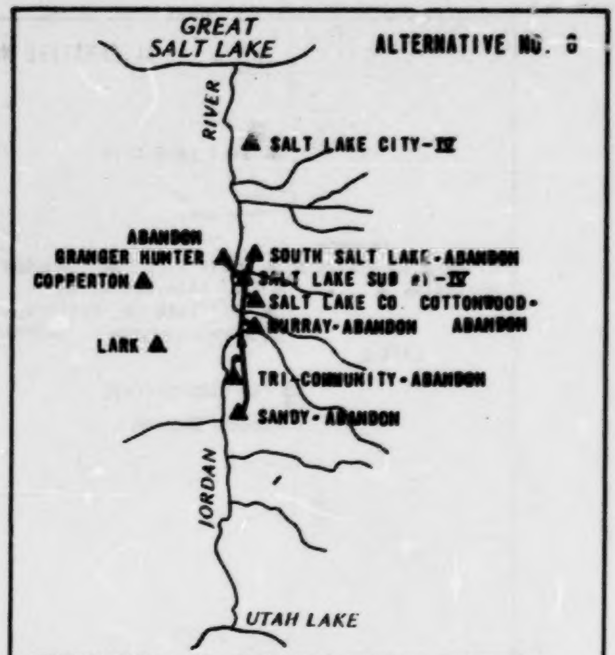
SAME AS 3, BUT LEVEL III TREATMENT.....................

FIGURE III-5 (Continued)

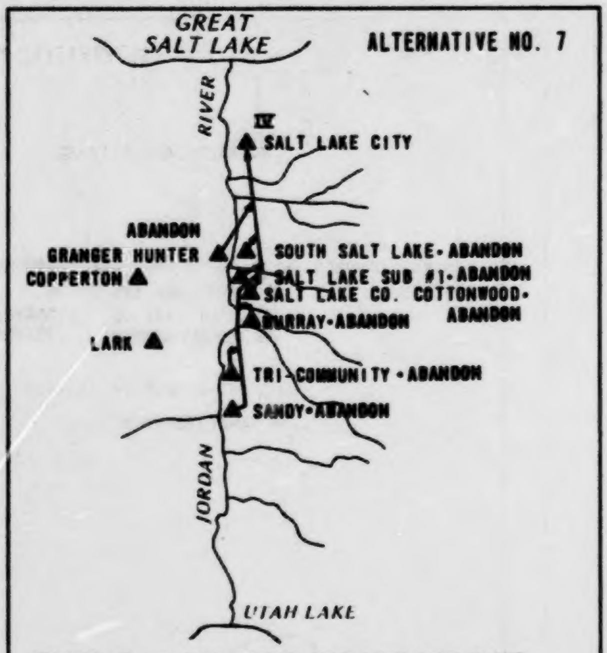
WASTEWATER TREATMENT ALTERNATIVES - SALT LAKE COUNTY


GREAT SALT LAKE
ALTERNATIVE NO. 5
RIVER
SALT LAKE CITY-IV
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-IV
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-IV
SANDY-ABANDON
JORDAN
UTAH LAKE

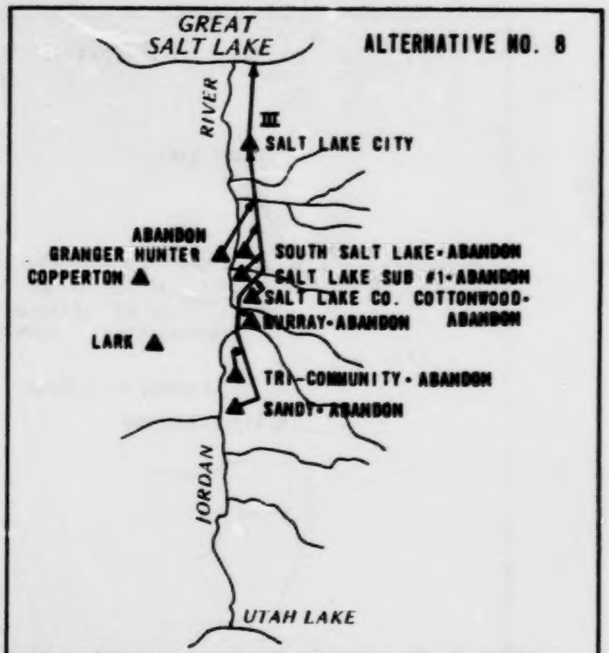
ABANDON SANDY, MURRAY, COTTONWOOD, GRANGER-HUNTER AND SOUTH SALT LAKE PLANTS. CONVEY FLOWS FROM SANDY TO TRI-COMMUNITY AND FROM MURRAY, COTTONWOOD, GRANGER-HUNTER AND SOUTH SALT LAKE TO SALT LAKE CITY SUBURBAN NO. 1. MODIFY AND EXPAND TRI COMMUNITY, SALT LAKE COUNTY SUBURBAN NO. 1 AND SALT LAKE CITY PLANTS. TREATMENT LEVEL IV.


GREAT SALT LAKE
ALTERNATIVE NO. 6
RIVER
SALT LAKE CITY-IV
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-IV
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-ABANDON
SANDY-ABANDON
JORDAN
UTAH LAKE

ABANDON SANDY, TRI-COMMUNITY, MURRAY, COTTONWOOD, GRANGER-HUNTER AND SOUTH SALT LAKE, AND CONVEY FLOWS TO SALT LAKE COUNTY SUBURBAN NO. 1. EXPAND AND MODIFY SALT LAKE COUNTY SUBURBAN NO. 1 AND SALT LAKE CITY PLANTS. TREATMENT LEVEL IV.


GREAT SALT LAKE
ALTERNATIVE NO. 7
RIVER
IV
SALT LAKE CITY
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-ABANDON
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-ABANDON
SANDY-ABANDON
JORDAN
UTAH LAKE

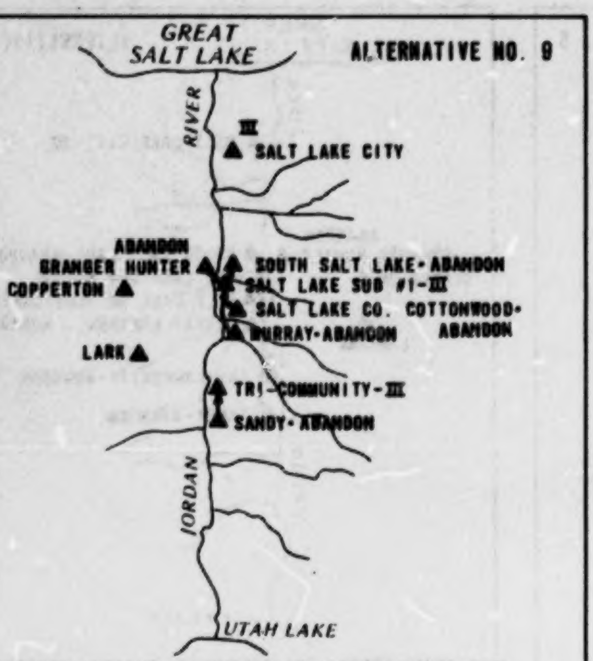
ABANDON ALL PLANTS EXCEPT SALT LAKE CITY PLANT. CONVEY ALL FLOWS TO MODIFIED AND EXPANDED SALT LAKE CITY PLANT. TREATMENT LEVEL IV.


GREAT SALT LAKE
ALTERNATIVE NO. 8
RIVER
III
SALT LAKE CITY
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-ABANDON
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-ABANDON
SANDY-ABANDON
JORDAN
UTAH LAKE

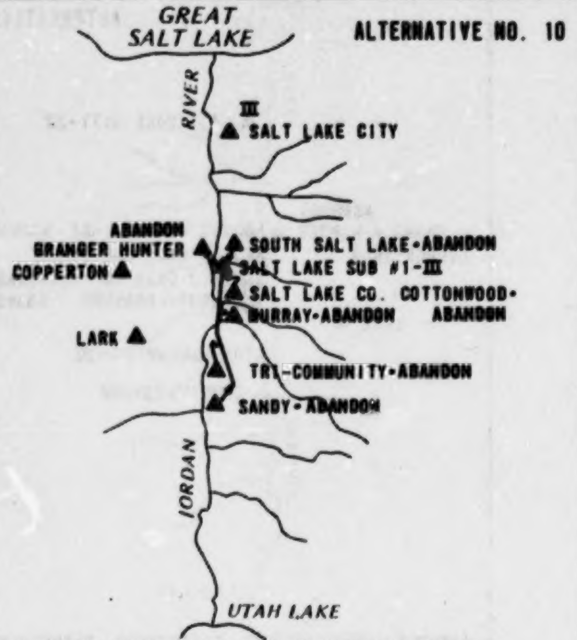
AS 7, BUT WITH LEVEL III TREATMENT AND AN OUTFALL TO GREAT SALT LAKE.

FIGURE III-5 (Continued)

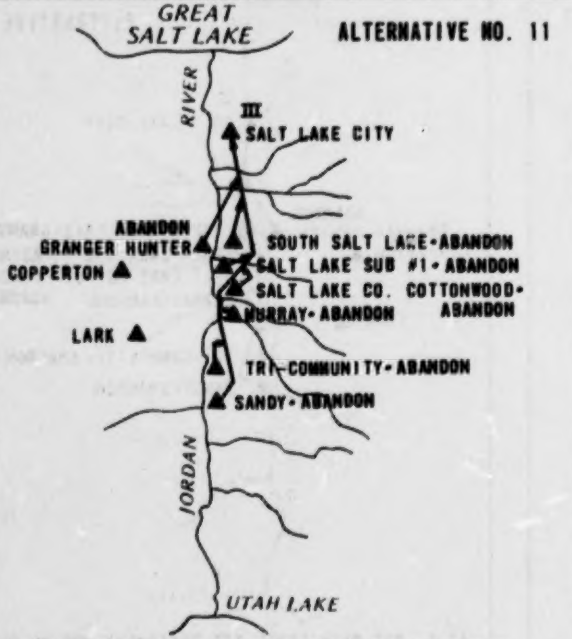
WASTEWATER TREATMENT ALTERNATIVES - SALT LAKE COUNTY


GREAT SALT LAKE
ALTERNATIVE NO. 9
RIVER
III
SALT LAKE CITY
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-III
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-III
SANDY-ABANDON
JORDAN
UTAH LAKE

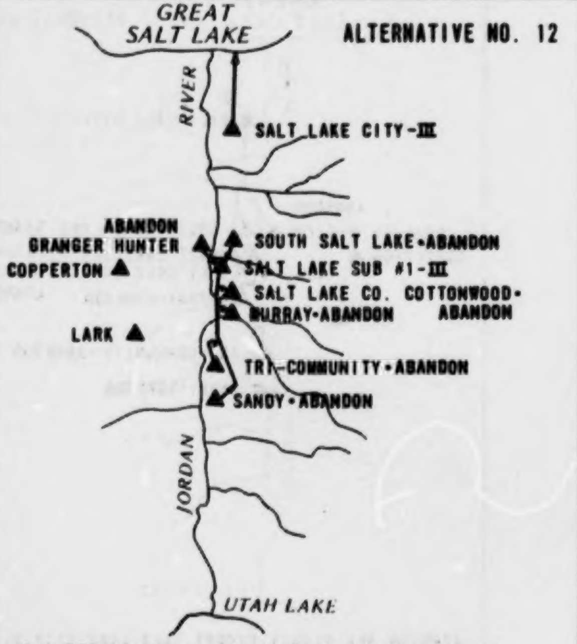
AS ALTERNATIVE 5, BUT WITH TREATMENT LEVEL III........


GREAT SALT LAKE
ALTERNATIVE NO. 10
RIVER
III
SALT LAKE CITY
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-III
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-ABANDON
SANDY-ABANDON
JORDAN
UTAH LAKE

AS ALTERNATIVE 6, BUT WITH TREATMENT LEVEL III........


GREAT SALT LAKE
ALTERNATIVE NO. 11
RIVER
III
SALT LAKE CITY
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-ABANDON
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-ABANDON
SANDY-ABANDON
JORDAN
UTAH LAKE

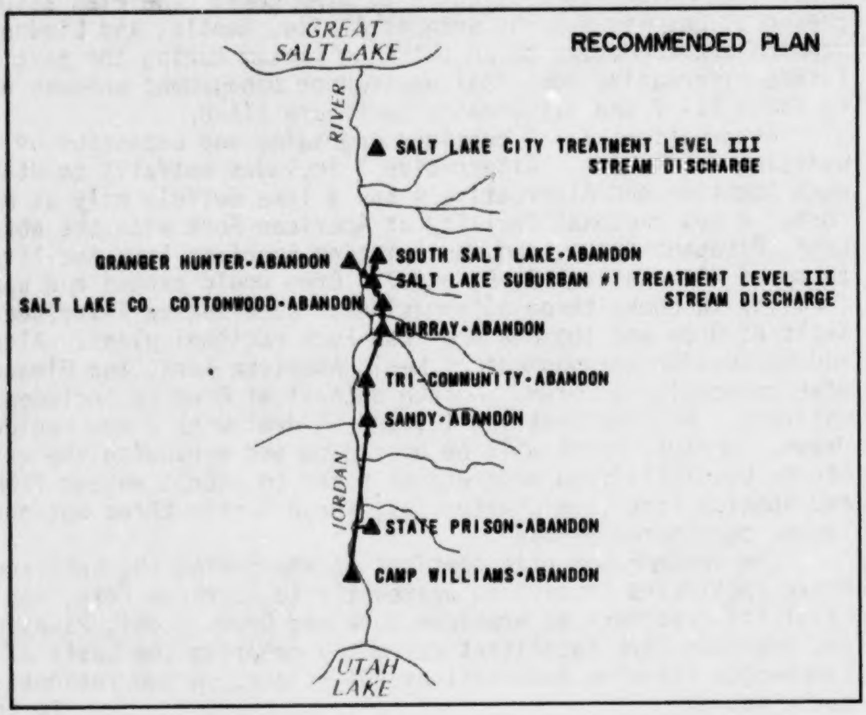
AS ALTERNATIVE 7, BUT WITH TREATMENT LEVEL III........


GREAT SALT LAKE
ALTERNATIVE NO. 12
RIVER
SALT LAKE CITY-III
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-III
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-ABANDON
SANDY-ABANDON
JORDAN
UTAH LAKE

AS ALTERNATIVE 10, BUT SALT LAKE CITY EMPLOYS LEVEL III TREATMENT WITH AN OUTFALL TO THE GREAT SALT LAKE.

FIGURE III-5 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - SALT LAKE COUNTY


GREAT SALT LAKE
RECOMMENDED PLAN
RIVER
SALT LAKE CITY TREATMENT LEVEL III STREAM DISCHARGE
SOUTH SALT LAKE-ABANDON
GRANGER HUNTER-ABANDON
SALT LAKE SUBURBAN #1 TREATMENT LEVEL III STREAM DISCHARGE
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
TRI-COMMUNITY-ABANDON
SANDY-ABANDON
JORDAN
STATE PRISON-ABANDON
CAMP WILLIAMS-ABANDON
UTAH LAKE

significant growth is not expected in these communities, the Plan recommends continuation of the existing systems. The ongoing 208 Programs are reviewing this recommendation.

Municipal Wastewater Management Alternatives - Magna Area (MA)

Municipal wastewater in the Magna area is currently treated in a trickling filter plant. Only one alternative is considered for future wastewater management; i.e., upgrading of the Magna facility to Level III.

Municipal Wastewater Management Alternatives - Northern Utah County (NUC)

Northern Utah County is defined as the area served by the Lehi, American Fork, Pleasant Grove, and Orem treatment plants. All these facilities except Orem discharge to ditches or streams leading to Utah Lake. Orem discharges directly to Utah Lake. The Plan assumed that presently unsewered areas such as Alpine, Manila, and Lindon will be sewered and connected to an existing system during the next twenty years. Future alternative municipal wastewater management schemes are presented in Table III-7 and illustrated in Figure III-6.

Alternatives 1 - 4 consider upgrading and expansion of the four existing facilities. Alternative 3 includes outfalls to Utah Lake at each location and Alternative 4 has a lake outfall only at American Fork. A new regional facility at American Fork with the abandonment of Lehi, Pleasant Grove, and the existing American Fork facility is the theme of Alternatives 5, 6, and 7. Orem would expand and upgrade its facility in these three alternatives. Alternative 7 includes lake outfalls at Orem and the new American Fork regional plant. Alternatives 8 and 9 consider abandonment of Lehi, American Fork, and Pleasant Grove with connection to Orem. A lake outfall at Orem is included in Alternative 8. Alternatives 10, 11, and 12 deal with a new regional plant at Provo. Because Provo will be upgrading and expanding the existing facility to Level III treatment and is sized to accept wastes from Springville and Spanish Fork (see Chapter IV), these latter three options are no longer considered viable.

The recommended plan consists of abandoning the Lehi and Pleasant Grove facilities, conveying wastewater to American Fork, and establishing Level III treatment at American Fork and Orem. Lehi, Pleasant Grove, and American Fork facilities currently comprise the basis of the Timpanogos Planning Associations 201 effort. A new regional plant is anticipated. In the interim, plans are underway to expand and upgrade the American Fork, Pleasant Grove, and Lehi facilities. A Step 1 - 201 Grant has been awarded to Orem to study the feasibility of Upgrading to Level III. Lindon is constructing a collection system and connecting to Orem. Alpine will convey its wastewater to the proposed Timpanogos facility.

Municipal Wastewater Management Alternatives - Central Utah County (CUC)

Central Utah County is defined as that area served by the Provo, Springville, Spanish Fork, Payson, and Salem treatment plants. In

TABLE III-7

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - NORTHERN UTAH COUNTY

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge to Utah Lake	Abandon/Connect To
NUC-1	Lehi		X		
	American Fork		X		
	Pleasant Grove		X		
	Orem		X		
NUC-2	Lehi	X			
	American Fork	X			
	Pleasant Grove	X			
	Orem	X			
NUC-3	Lehi	X		X	
	American Fork	X		X	
	Pleasant Grove	X		X	
	Orem	X		X	
NUC-4	Lehi		X		
	American Fork	X		X	
	Pleasant Grove		X		
	Orem		X		
NUC-5	Lehi				New American Fork (IV)
	American Fork				New American Fork (IV)
	Pleasant Grove				New American Fork (IV)
	Orem		X		
NUC-6	Lehi				New American Fork (III)
	American Fork				New American Fork (III)
	Pleasant Grove				New American Fork (III)
	Orem	X			

TABLE III-7 (Continued)

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - NORTHERN UTAH COUNTY

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge to Utah Lake	Abandon/Connect To
NUC-7	Lehi				New American Fork (III + Lake)
	American Fork				New American Fork (III + Lake)
	Pleasant Grove				New American Fork (III + Lake)
	Orem	X		X	
NUC-8	Lehi				Orem
	American Fork				Orem
	Pleasant Grove				Orem
	Orem	X		X	
NUC-9	Lehi				Orem
	American Fork				Orem
	Pleasant Grove				Orem
	Orem		X		
NUC-10	Lehi				New Provo (III + Lake)
	American Fork				New Provo (III + Lake)
	Pleasant Grove				New Provo (III + Lake)
	Orem				New Provo (III + Lake)
NUC-11	Lehi				New Provo (IV + Bay)
	American Fork				New Provo (IV + Bay)
	Pleasant Grove				New Provo (IV + Bay)
	Orem				New Provo (IV + Bay)
NUC-12	Lehi				New Provo (III + Bay)
	American Fork				New Provo (III + Bay)
	Pleasant Grove				New Provo (III + Bay)
	Orem				New Provo (III + Bay)

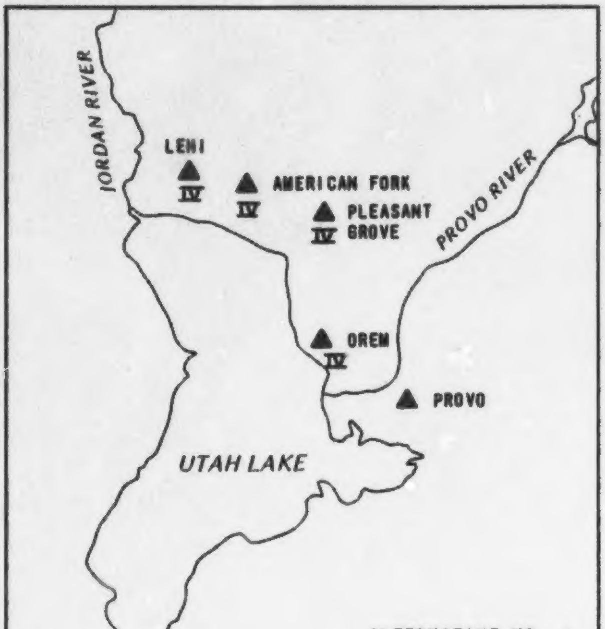
TABLE III-7 (Continued)

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - NORTHERN UTAH COUNTY

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge to Utah Lake	Abandon/Connect To
Recommended Plan	Lehi	⟶	⟶	⟶	American Fork
	American Fork	X			
	Pleasant Grove	⟶	⟶	⟶	American Fork
	Orem	X			

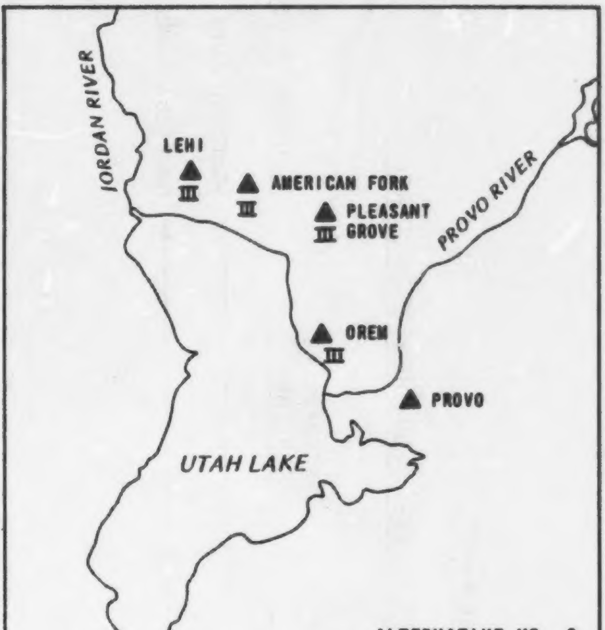
FIGURE III-6

WASTEWATER TREATMENT ALTERNATIVES - NORTHERN UTAH COUNTY


JORDAN RIVER
LEHI
IV
AMERICAN FORK
IV
PLEASANT GROVE
IV
PROVO RIVER
OREM
IV
PROVO
UTAH LAKE

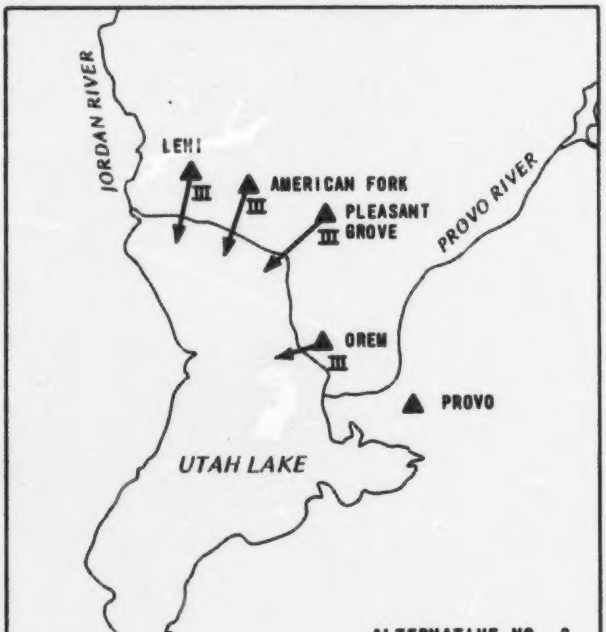
ALTERNATIVE NO. 1

MODIFY AND EXPAND EXISTING PLANTS AT EXISTING LOCATIONS. LEVEL IV TREATMENT AT ALL PLANTS.


JORDAN RIVER
LEHI
III
AMERICAN FORK
III
PLEASANT GROVE
III
PROVO RIVER
OREM
III
PROVO
UTAH LAKE

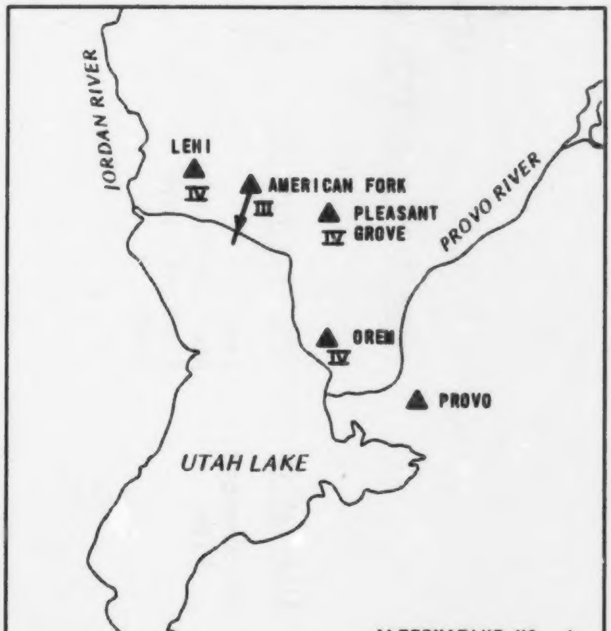
ALTERNATIVE NO. 2

SAME AS ALTERNATIVE 1, BUT TREATMENT LEVEL III........


JORDAN RIVER
LEHI
III
AMERICAN FORK
III
PLEASANT GROVE
III
PROVO RIVER
OREM
III
PROVO
UTAH LAKE

ALTERNATIVE NO. 3

MODIFY AND EXPAND EXISTING PLANTS AT EXISTING LOCATIONS. LEVEL III TREATMENT AND LAKE OUTFALLS AT EACH POINT.

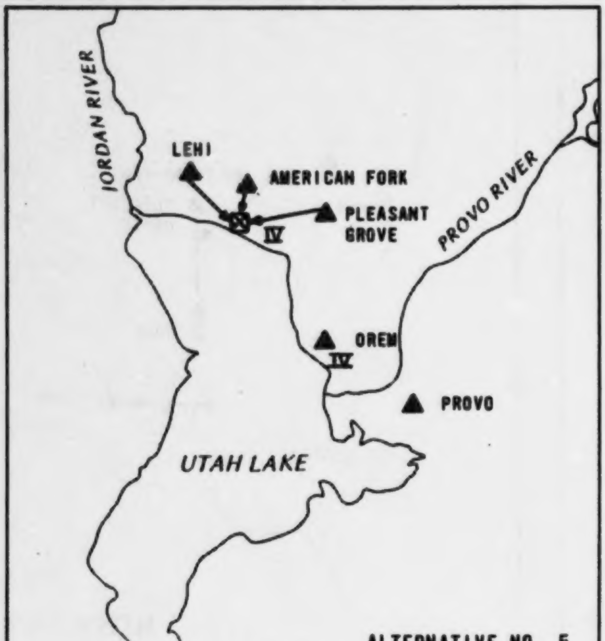

JORDAN RIVER
LEHI
IV
AMERICAN FORK
III
PLEASANT GROVE
IV
PROVO RIVER
OREM
IV
PROVO
UTAH LAKE

ALTERNATIVE NO. 4

MODIFY AND EXPAND EXISTING PLANTS AT EXISTING LOCATIONS. LEVEL IV TREATMENT AT LEHI, PLEASANT GROVE AND OREM. LEVEL III TREATMENT AT AMERICAN FORK WITH OUTFALL EXTENDED INTO LAKE.

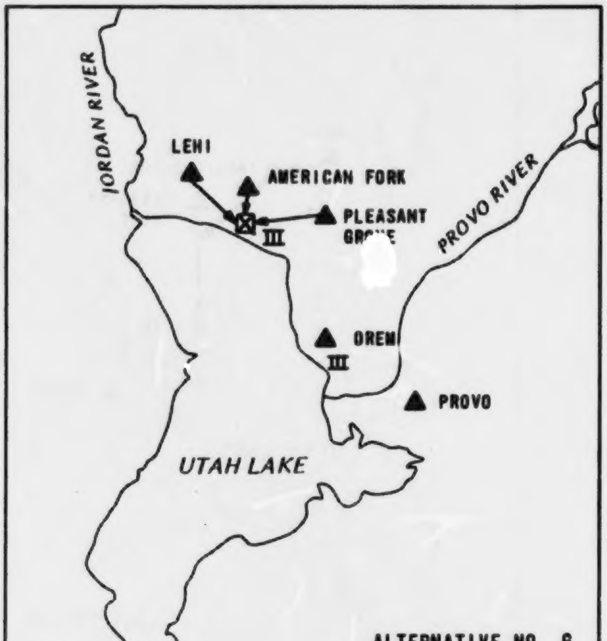
FIGURE III-6 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - NORTHERN UTAH COUNTY


JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
IV
PROVO RIVER
OREM
IV
PROVO
UTAH LAKE

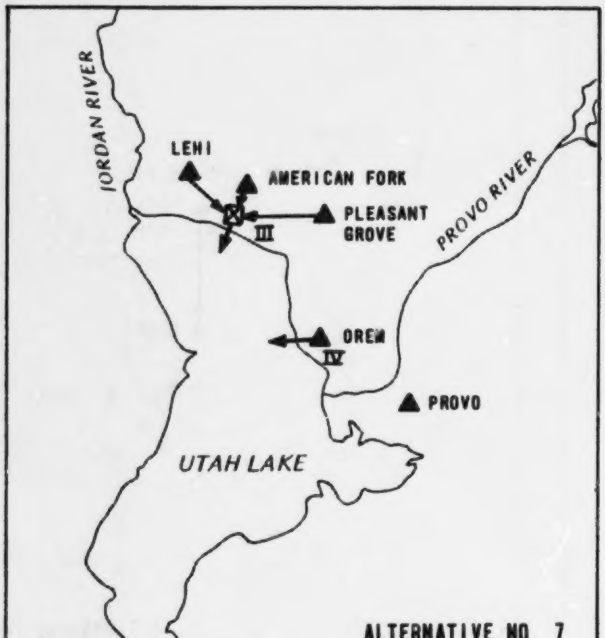
ALTERNATIVE NO. 5

CONVEY FLOWS FROM LEHI, PLEASANT GROVE AND AMERICAN FORK TO NEW REGIONAL PLANT NEAR AMERICAN FORK. OREM REMAINS SEPARATE. LEVEL IV TREATMENT AT ALL PLANTS.


JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
III
PROVO RIVER
OREM
III
PROVO
UTAH LAKE

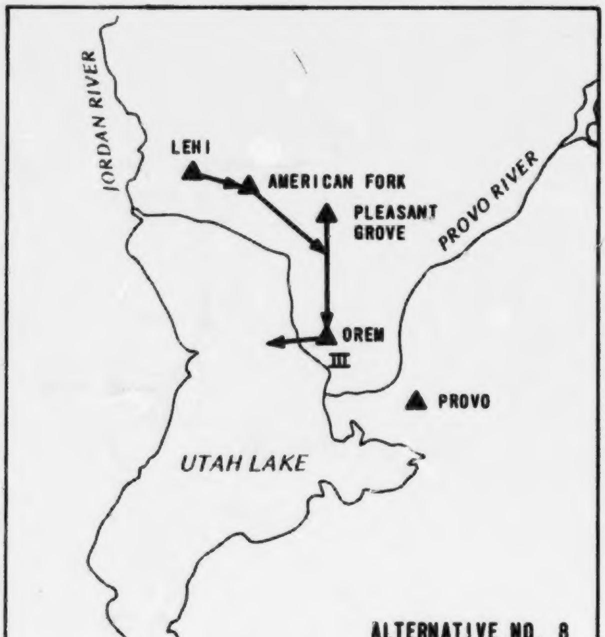
ALTERNATIVE NO. 6

AS ALTERNATIVE 5, BUT LEVEL III TREATMENT............


JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
III
PROVO RIVER
OREM
IV
PROVO
UTAH LAKE

ALTERNATIVE NO. 7

CONVEY, FLOWS FROM LEHI, PLEASANT GROVE AND AMERICAN FORK TO NEW REGIONAL PLANT NEAR AMERICAN FORK. OREM REMAINS SEPARATE. LEVEL III TREATMENT WITH OUTFALLS TO LAKE FROM OREM AND REGIONAL PLANT.

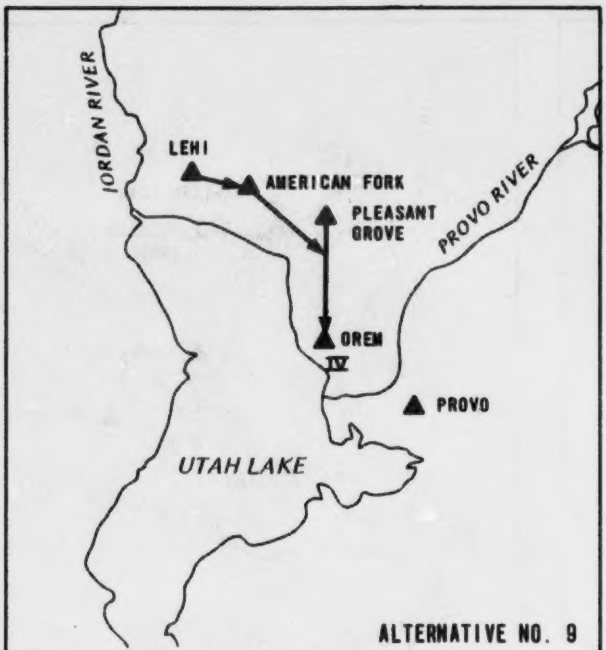

JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
OREM
III
PROVO
UTAH LAKE

ALTERNATIVE NO. 8

CONVEY FLOWS FROM LEHI, PLEASANT GROVE AND AMERICAN FORK TO EXPANDED OREM PLANT. IMPLEMENT TREATMENT LEVEL III WITH LAKE OUTFALL

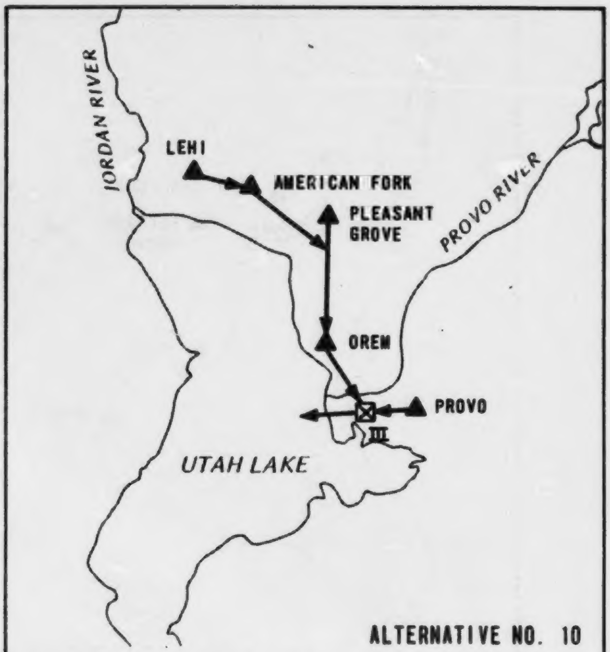
FIGURE III-6 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - NORTHERN UTAH COUNTY


JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
OREM
IV
PROVO
UTAH LAKE

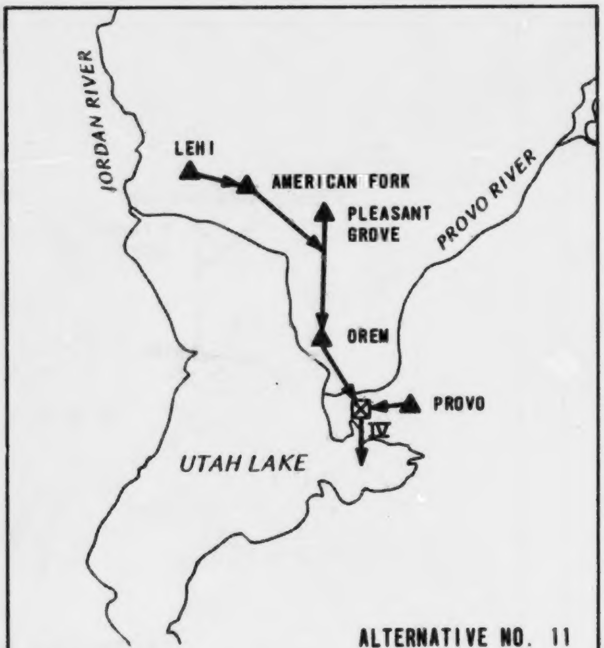
ALTERNATIVE NO. 9

SAME AS ALTERNATIVE 8, BUT WITH LEVEL IV TREATMENT AT OREM PLANT; DISCHARGE TO SLOUGH.


JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
OREM
PROVO
III
UTAH LAKE

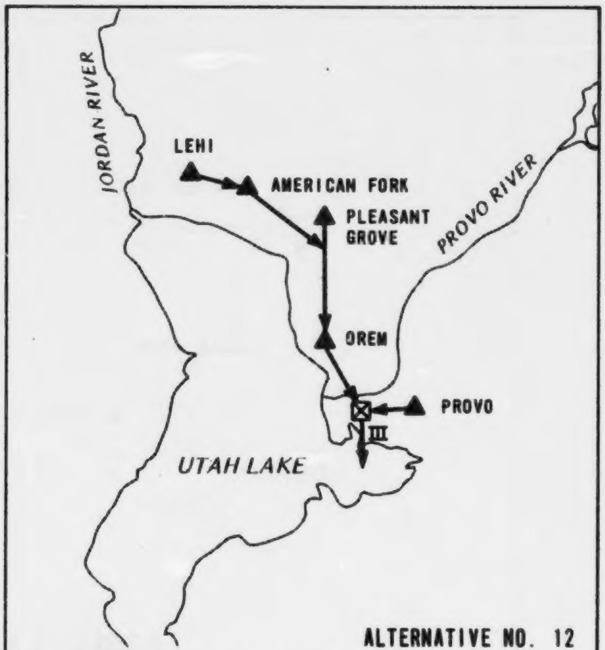
ALTERNATIVE NO. 10

CONVEY FLOWS FROM LEHI, PLEASANT GROVE, AMERICAN FORK AND OREM TO NEW REGIONAL PLANT NEAR PROVO. TREATMENT LEVEL III WITH LAKE OUTFALL.


JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
OREM
PROVO
IV
UTAH LAKE

ALTERNATIVE NO. 11

SAME AS ALTERNATIVE 10, BUT WITH LEVEL IV TREATMENT AT NEW REGIONAL PLANT NEAR PROVO. DISCHARGE TO PROVO BAY.

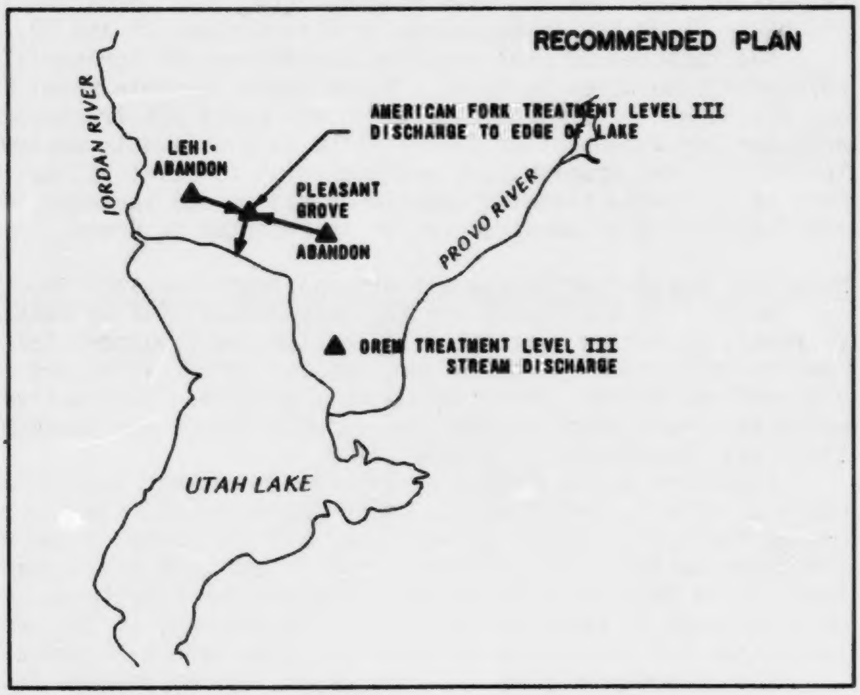

JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
OREM
PROVO
III
UTAH LAKE

ALTERNATIVE NO. 12

AS ALTERNATIVE 11, BUT WITH LEVEL III TREATMENT......

FIGURE III-6 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - NORTHERN UTAH COUNTY


RECOMMENDED PLAN
JORDAN RIVER
AMERICAN FORK TREATMENT LEVEL III
DISCHARGE TO EDGE OF LAKE
LEHI-
ABANDON
PLEASANT
GROVE
ABANDON
PROVO RIVER
OREM TREATMENT LEVEL III
STREAM DISCHARGE
UTAH LAKE

developing wastewater management alternatives, it was assumed that unsewered areas such as Mapleton and Salem Hills will be sewered and connected to existing system during the planning period. Alternative future wastewater management schemes for Central Utah County are presented in Table III-8 and illustrated in Figure III-7.

Upgrading and expansion of the existing treatment facilities is suggested in Alternatives 1 and 2. Abandonment of Salem's facility and connection to Payson is considered in Alternatives 3 and 4. Alternatives 5, 6, and 7 focus on abandonment of Springville and Spanish Fork and connection to Provo. A discharge to Utah Lake is suggested for Provo in Alternative 7. In Alternatives 8 and 9, only Springville is abandoned and connected to Provo. A discharge to Utah Lake at Provo is included in both alternatives. Springville, Spanish Fork, Salem, and Payson are all abandoned and connected to Provo in Alternatives 10, 11, and 12. An outfall to Utah Lake at Provo is considered in Alternative 10 while discharge to Provo Bay is suggested in Alternatives 11 and 12.

The recommended plan requires abandonment of Springville and Spanish Fork with connection to Provo. Salem would maintain Level II treatment and discharge its effluent to Payson for Level III treatment. Provo is anticipating expansion of its facility to accommodate wastewater from Springville and Spanish Fork and upgrading to Level III by 1978. Spanish Fork is currently planning interim upgrading and Springville is studying the feasibility of constructing an interceptor to Provo.

Municipal Wastewater Management Alternatives - Wasatch County (WC)

Heber City and Midway are the only communities in Wasatch County currently operating wastewater collection and treatment facilities. Heber's collection system suffers massive infiltration and all future alternatives assume correction of this problem. Alternative future wastewater management systems for Wasatch County are presented in Table III-9 and illustrated in Figure III-8.

Expansion and upgrading of existing treatment facilities is the basis of Alternatives 1 and 2. Alternative 2 specifies a Provo River discharge for Heber. Alternatives 3, 4, and 5 consider a new regional facility for Heber Valley. Alternatives 3 and 5 require a discharge to the Provo River above Deer Creek Reservoir. Alternative 4 includes Level II treatment followed by percolation basins. Abandonment of the Heber and Midway facilities and connection to Provo is suggested in Alternative 6.

The recommended plan includes Level II treatment at Midway and Heber and effluent conveyance to a new regional facility at Charleston for Level III treatment. It was also assumed that wastewater from Wallsburg would be collected and conveyed out of the County to Provo by means of the proposed Provo Canyon interceptor. Heber City is currently involved in infiltration control and Midway is studying upgrading measures. Additionally, the Provo Canyon Sewer District is actively studying the feasibility of the Provo Canyon interceptor.

Municipal Wastewater Management Alternatives - Overall Utah and Wasatch Counties (OU/WC)

In addition to the separate alternatives for Northern Utah County, Central Utah County, and Wasatch County previously discussed, several

TABLE III-8

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - CENTRAL UTAH COUNTY

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge to Utah Lake	Abandon/Connect To
CUC-1	Provo		X		
	Springville		X		
	Spanish Fork		X		
	Salem		X		
	Payson		X		
CUC-2	Provo	X			
	Springville	X			
	Spanish Fork	X			
	Salem	X			
	Payson	X			
CUC-3	Provo		X		
	Springville		X		
	Spanish Fork		X		
	Salem	→	→	→	Payson
	Payson		X		
CUC-4	Provo	X			
	Springville	X			
	Spanish Fork	X			
	Salem	→	→	→	Payson
	Payson	X			
CUC-5	Provo		X		
	Springville	→	→	→	Provo
	Spanish Fork	→	→	→	Provo
	Salem		X		
	Payson		X		

TABLE III-8 (Continued)

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - CENTRAL UTAH COUNTY

Alternative	Treatment Facility	Treatment Level		Discharge to Utah Lake	Abandon/Connect To
		III	IV		
CUC-6	Provo	X			
	Springville	→	→	→	Provo
	Spanish Fork	→	→	→	Provo
	Salem	X			
	Payson	X			
CUC-7	Provo	X		X	
	Springville	→	→	→	Provo
	Spanish Fork	→	→	→	Provo
	Salem	X			
	Payson	X			
CUC-8	Provo	X		X	
	Springville	→	→	→	Provo
	Spanish Fork		X		
	Salem		X		
	Payson		X		
CUC-9	Provo	X		X	
	Springville	→	→	→	Provo
	Spanish Fork	X			
	Salem	X			
	Payson	X			
CUC-10	Provo	X		X	
	Springville	→	→	→	Provo
	Spanish Fork	→	→	→	Provo
	Salem	→	→	→	Provo
	Payson	→	→	→	Provo

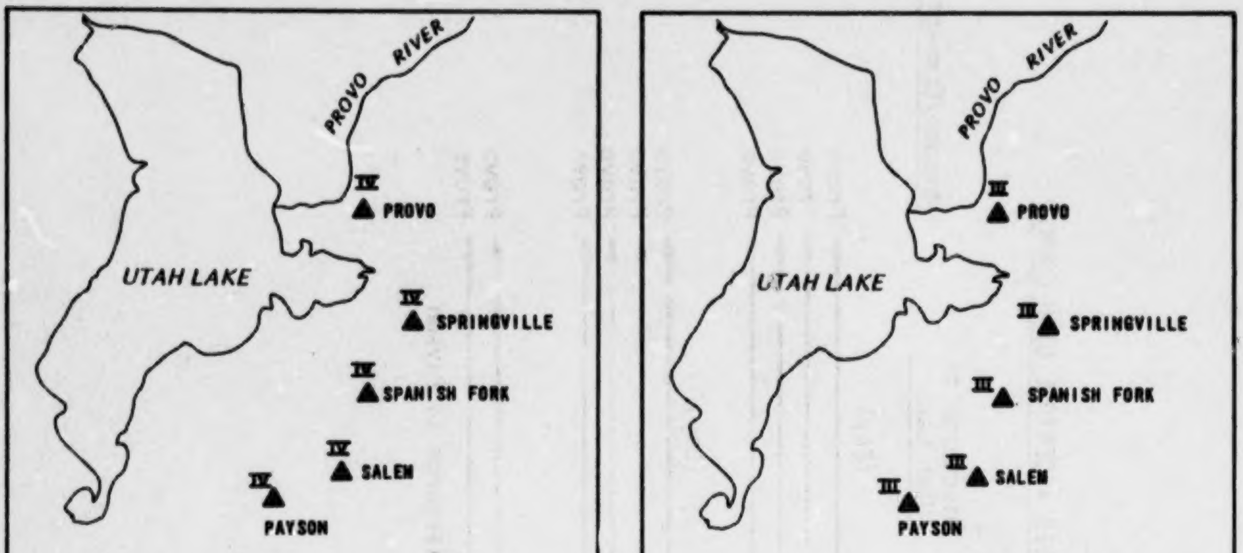
TABLE III-8 (Continued)

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - CENTRAL UTAH COUNTY

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge to Utah Lake	Abandon/Connect To
CUC-11	Provo		X	(Bay)	
	Springville				→ Provo
	Spanish Fork				→ Provo
	Salem				→ Provo
	Payson				→ Provo
CUC-12	Provo	X		(Bay)	
	Springville				→ Provo
	Spanish Fork				→ Provo
	Salem				→ Provo
	Payson				→ Provo
Recommended Plan	Provo	X			
	Springville				→ Provo
	Spanish Fork				→ Provo
	Salem		Level II Discharge to Payson		
	Payson	X			

FIGURE III-7

WASTEWATER TREATMENT ALTERNATIVES - CENTRAL UTAH COUNTY

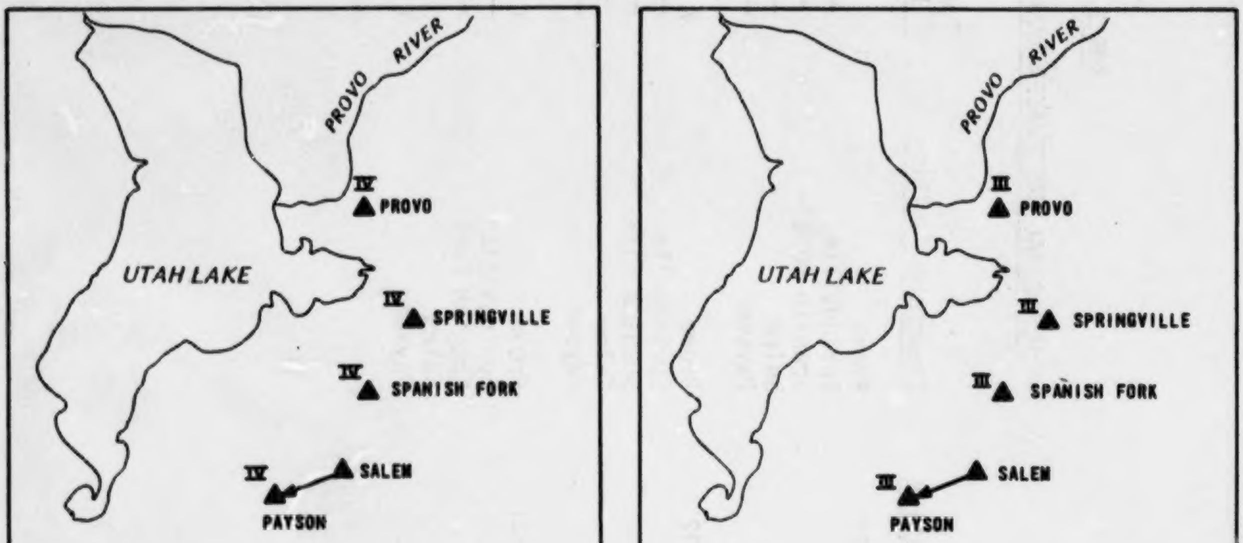

PROVO RIVER
UTAH LAKE
IV PROVO
IV SPRINGVILLE
IV SPANISH FORK
IV SALEM
IV PAYSON
PROVO RIVER
UTAH LAKE
III PROVO
III SPRINGVILLE
III SPANISH FORK
III SALEM
III PAYSON

ALTERNATIVE NO. 1

MODIFY AND EXPAND EXISTING PLANTS AT EXISTING LOCATIONS. TREATMENT LEVEL IV.

ALTERNATIVE NO. 2

AS ALTERNATIVE 1, BUT LEVEL III TREATMENT............


PROVO RIVER
UTAH LAKE
IV PROVO
IV SPRINGVILLE
IV SPANISH FORK
SALEM
IV PAYSON
PROVO RIVER
UTAH LAKE
III PROVO
III SPRINGVILLE
III SPANISH FORK
SALEM
III PAYSON

ALTERNATIVE NO. 3

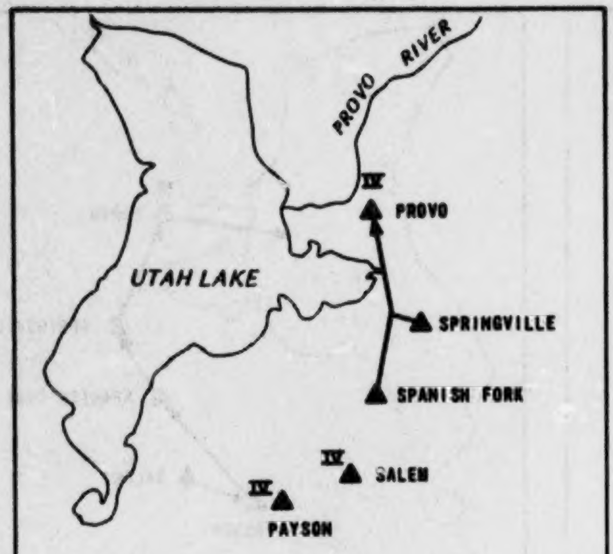
MODIFY AND EXPAND EXISTING PLANTS AT EXISTING LOCATIONS. CONVEY FLOWS FROM SALEM TO PAYSON. TREATMENT LEVEL IV.

ALTERNATIVE NO. 4

AS ALTERNATIVE 3, BUT LEVEL III TREATMENT............

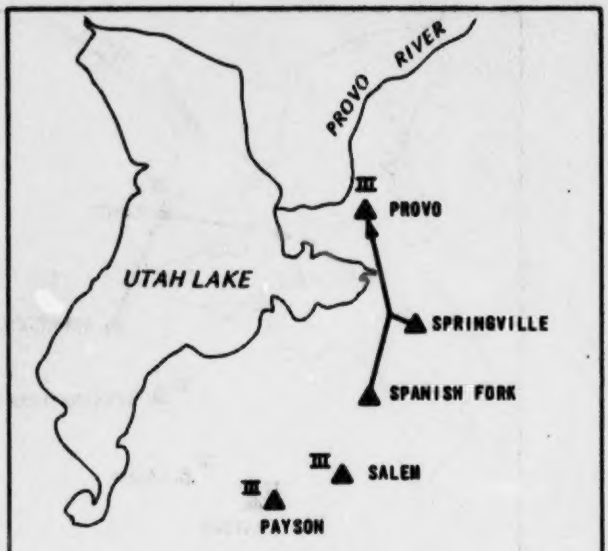
FIGURE III-7 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - CENTRAL UTAH COUNTY


PROVO RIVER
IV
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
IV
SALEM
IV
PAYSON

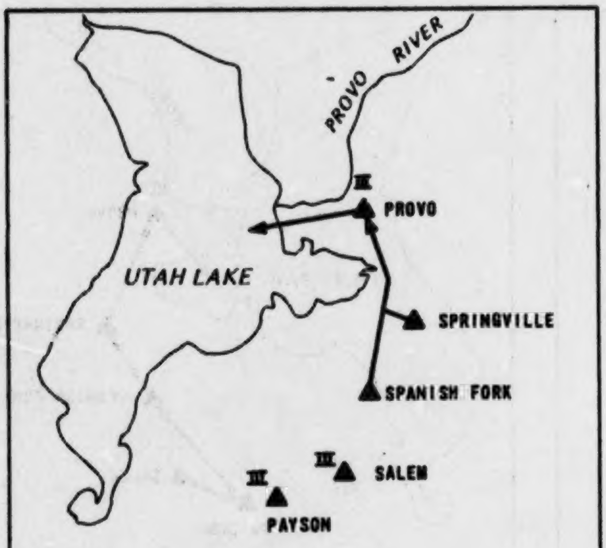
ALTERNATIVE NO. 5

CONVEY FLOWS FROM SPANISH FORK AND SPRINGVILLE TO EXPANDED PROVO PLANT. SALEM AND PAYSON PLANTS REMAIN AT EXISTING LOCATIONS. LEVEL IV TREATMENT.


PROVO RIVER
III
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
III
SALEM
III
PAYSON

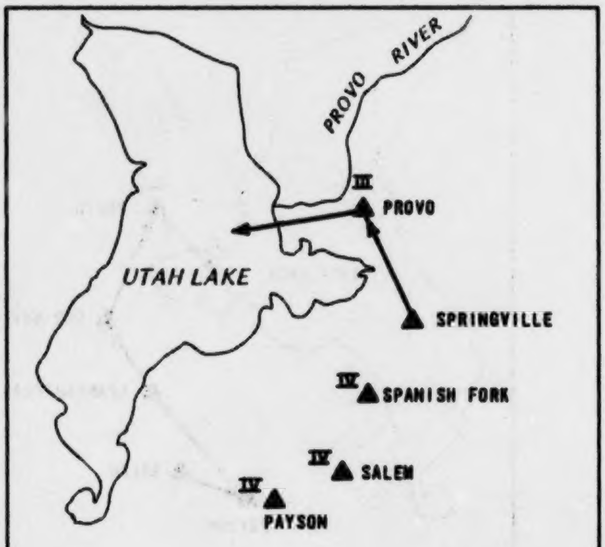
ALTERNATIVE NO. 6

AS ALTERNATIVE 5, BUT LEVEL III TREATMENT............


PROVO RIVER
III
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
III
SALEM
III
PAYSON

ALTERNATIVE NO. 7

CONVEY FLOWS FROM SPANISH FORK AND SPRINGVILLE TO EXPANDED PROVO PLANT. LEVEL III TREATMENT, LAKE OUTFALL. SALEM AND PAYSON REMAIN AT PRESENT LOCATIONS WITH LEVEL III TREATMENT.

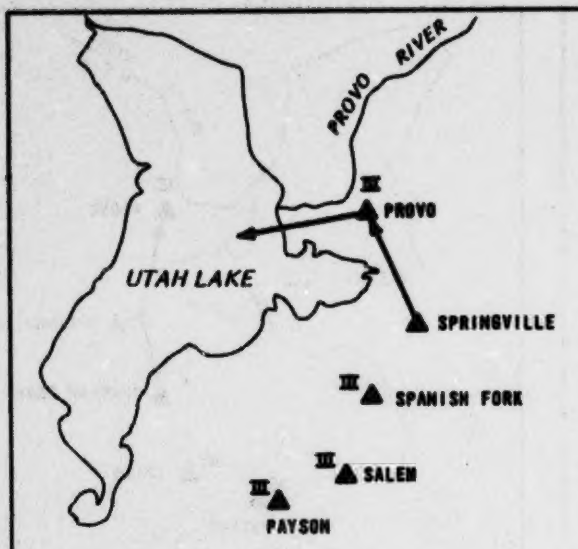

PROVO RIVER
III
PROVO
UTAH LAKE
SPRINGVILLE
IV
SPANISH FORK
IV
SALEM
IV
PAYSON

ALTERNATIVE NO. 8

CONVEY FLOW FROM SPRINGVILLE TO PROVO; LEVEL III TREATMENT WITH LAKE OUTFALL. SPANISH FORK, PAYSON AND SALEM REMAIN SEPARATE. LEVEL IV TREATMENT.

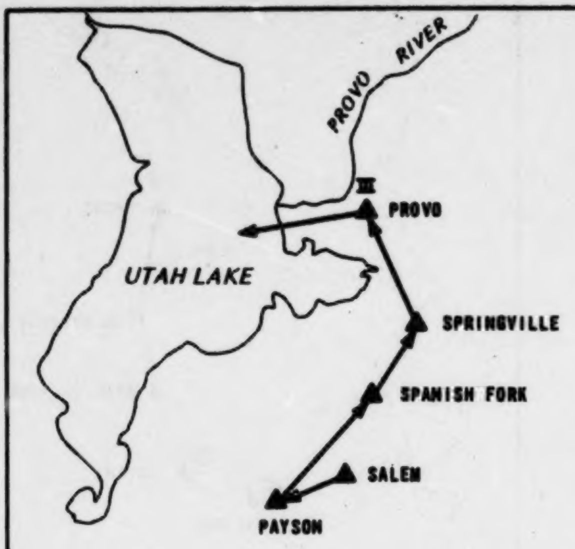
FIGURE III-7 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - CENTRAL UTAH COUNTY


PROVO RIVER
III
PROVO
UTAH LAKE
SPRINGVILLE
III
SPANISH FORK
III
SALEM
III
PAYSON

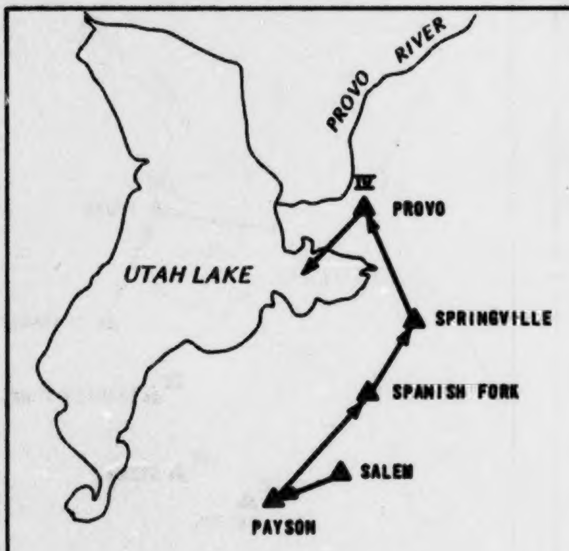
ALTERNATIVE NO. 9

AS ALTERNATIVE 8, BUT LEVEL III TREATMENT AT ALL PLANTS.


PROVO RIVER
III
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
SALEM
PAYSON

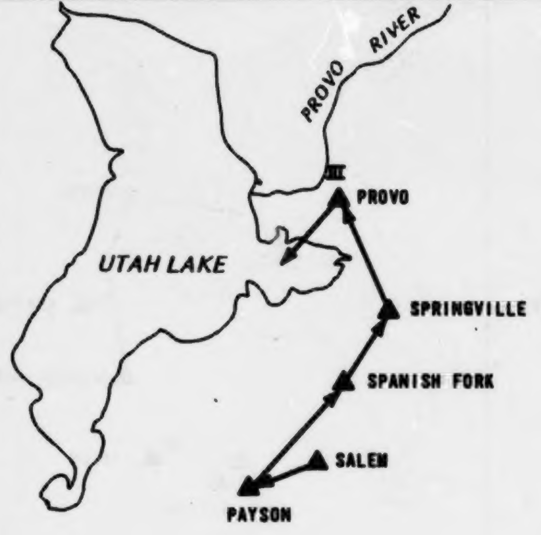
ALTERNATIVE NO. 10

CONVEY FLOWS FROM SPANISH FORK, SPRINGVILLE, SALEM AND PAYSON TO EXPANDED PROVO PLANT. LEVEL III TREATMENT, LAKE OUTFALL.


PROVO RIVER
IV
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
SALEM
PAYSON

ALTERNATIVE NO. 11

CONVEY FLOWS FROM SPANISH FORK, SPRINGVILLE, SALEM AND PAYSON TO EXPANDED PROVO PLANT. LEVEL IV TREATMENT; DISCHARGE TO PROVO BAY.

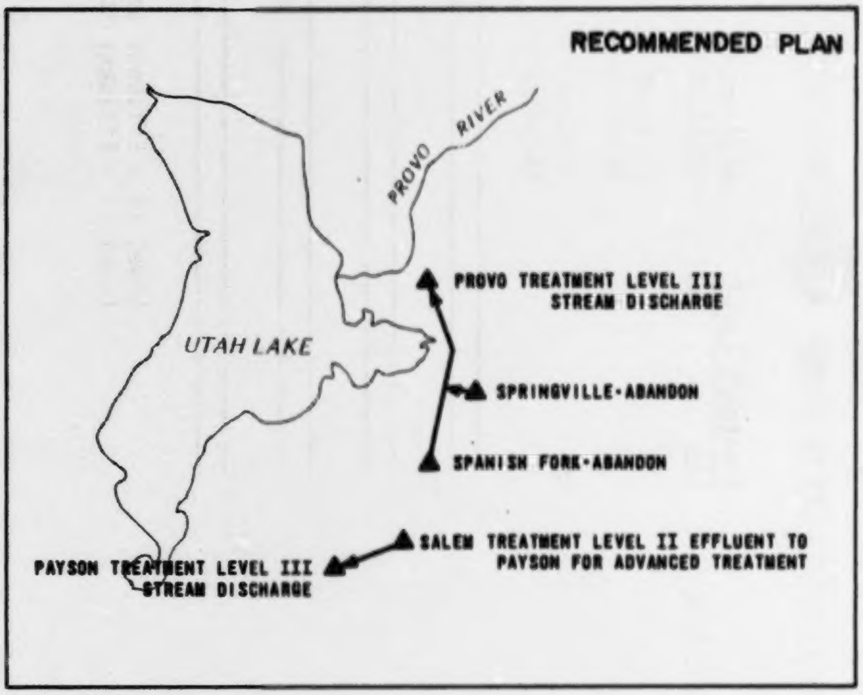

PROVO RIVER
III
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
SALEM
PAYSON

ALTERNATIVE NO. 12

AS ALTERNATIVE 11, BUT LEVEL III TREATMENT.

FIGURE III-7 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - CENTRAL UTAH COUNTY



RECOMMENDED PLAN
PROVO RIVER
UTAH LAKE
PROVO TREATMENT LEVEL III STREAM DISCHARGE
SPRINGVILLE-ABANDON
SPANISH FORK-ABANDON
SALEM TREATMENT LEVEL II EFFLUENT TO PAYSON FOR ADVANCED TREATMENT
PAYSON TREATMENT LEVEL III STREAM DISCHARGE

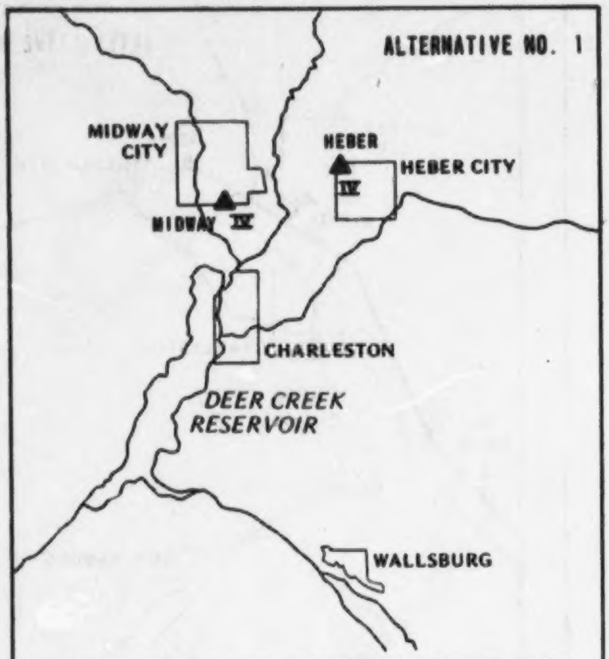
TABLE III-9

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - WASATCH COUNTY

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge Location	Abandon/Connect To
WC-1	Heber		X	Existing	
	Midway		X	Existing	
WC-2	Heber	X		Provo R.	
	Midway	X		Existing	
WC-3	Heber				New Charleston
	Midway				Level III - Provo R.
WC-4	Heber				New South of Heber
	Midway				Level II - Percolation
WC-5	Heber				New South of Heber
	Midway				Level IV - Provo R.
WC-6	Heber				Provo
	Midway				Provo
Recommended Plan	Heber			Level II - Effluent to Charleston Level III	
	Midway			Level II - Effluent to Charleston Level III	

FIGURE III-8

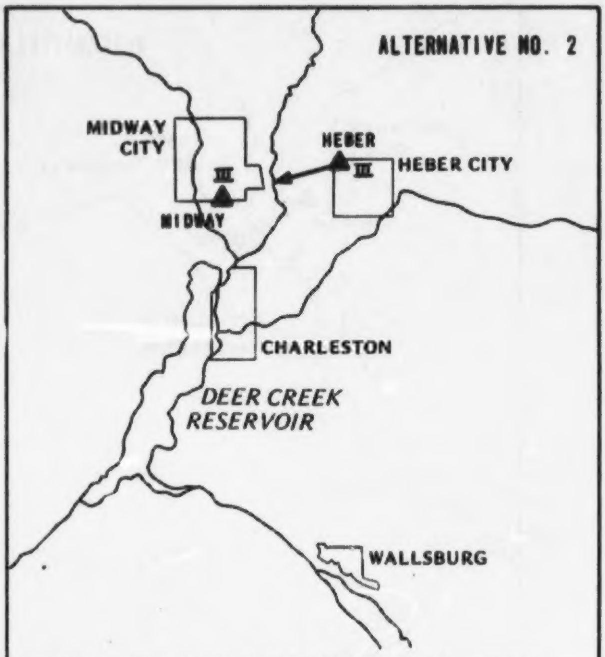
WASTEWATER TREATMENT ALTERNATIVES - WASATCH COUNTY



ALTERNATIVE NO. 1

MIDWAY CITY
HEBER
HEBER CITY
IV
MIDWAY
IV
CHARLESTON
DEER CREEK RESERVOIR
WALLSBURG

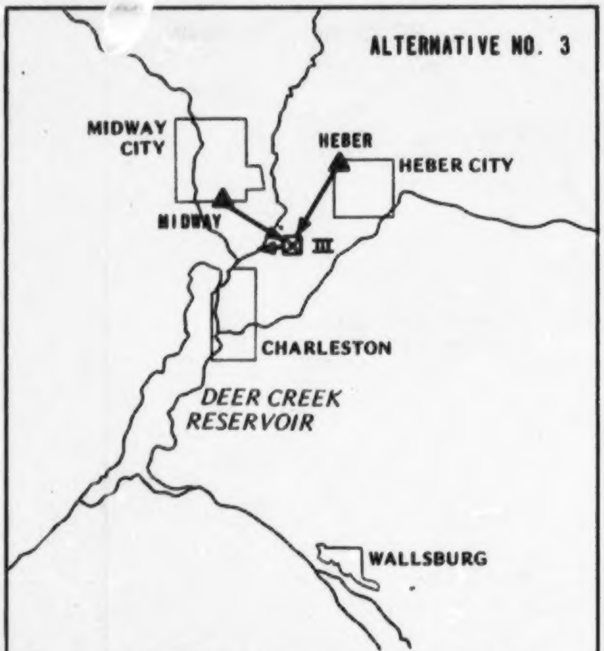
MODIFY EXISTING PLANTS AT PRESENT LOCATIONS, WITH TREATMENT LEVEL IV AT HEBER AND MIDWAY PLANTS. DISCHARGE POINTS AS EXISTING ON SPRING AND SNAKE CREEKS.



ALTERNATIVE NO. 2

MIDWAY CITY
III
MIDWAY
HEBER
III
HEBER CITY
CHARLESTON
DEER CREEK RESERVOIR
WALLSBURG

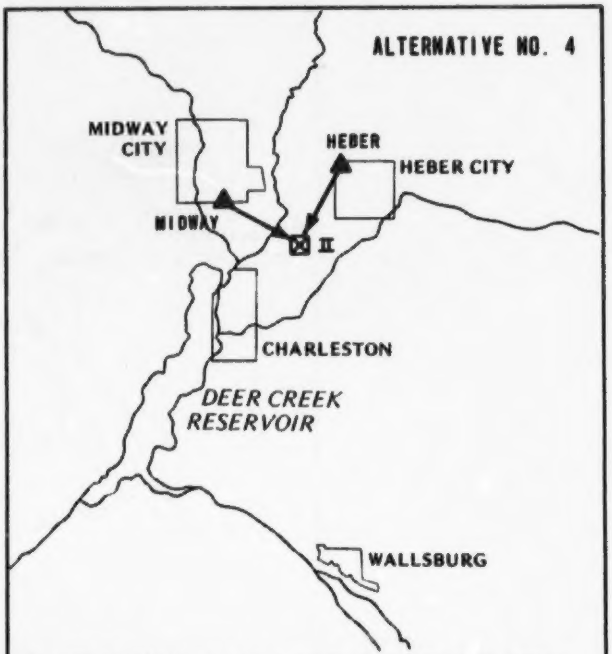
MODIFY EXISTING PLANTS AT PRESENT LOCATIONS WITH TREATMENT LEVEL III AT HEBER AND AT MIDWAY. HEBER TO CONSTRUCT OUTFALL TO PROVO RIVER; MIDWAY TO CONTINUE DISCHARGE AT PRESENT SITE.



ALTERNATIVE NO. 3

MIDWAY CITY
HEBER
HEBER CITY
MIDWAY
III
CHARLESTON
DEER CREEK RESERVOIR
WALLSBURG

CONVEY ALL SEWAGE TO NEW REGIONAL PLANT TO BE CONSTRUCTED NEAR CHARLESTON. TREATMENT LEVEL III WITH OUTFALL TO PROVO RIVER.



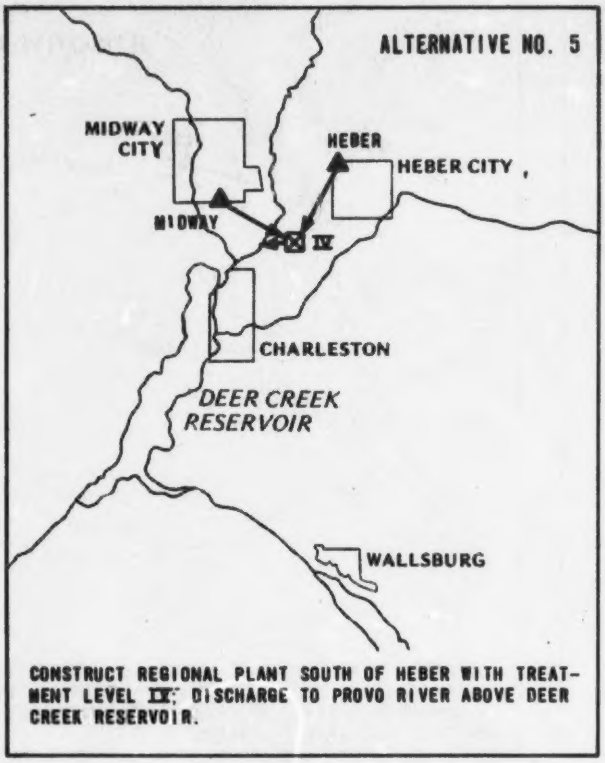
ALTERNATIVE NO. 4

MIDWAY CITY
HEBER
HEBER CITY
MIDWAY
II
CHARLESTON
DEER CREEK RESERVOIR
WALLSBURG

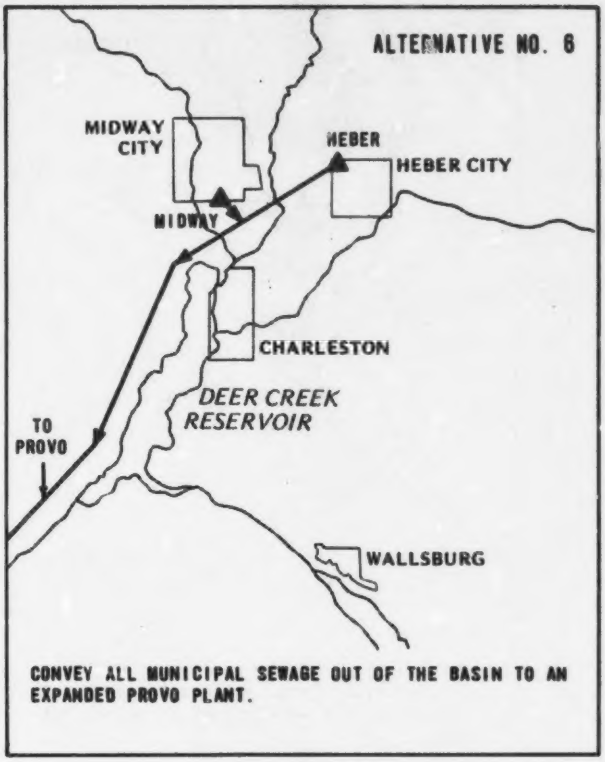
CONSTRUCT REGIONAL PLANT SOUTH OF HEBER WITH TREATMENT LEVEL II FOLLOWED BY PERCOLATION BASINS.

FIGURE III-8 (Continued)

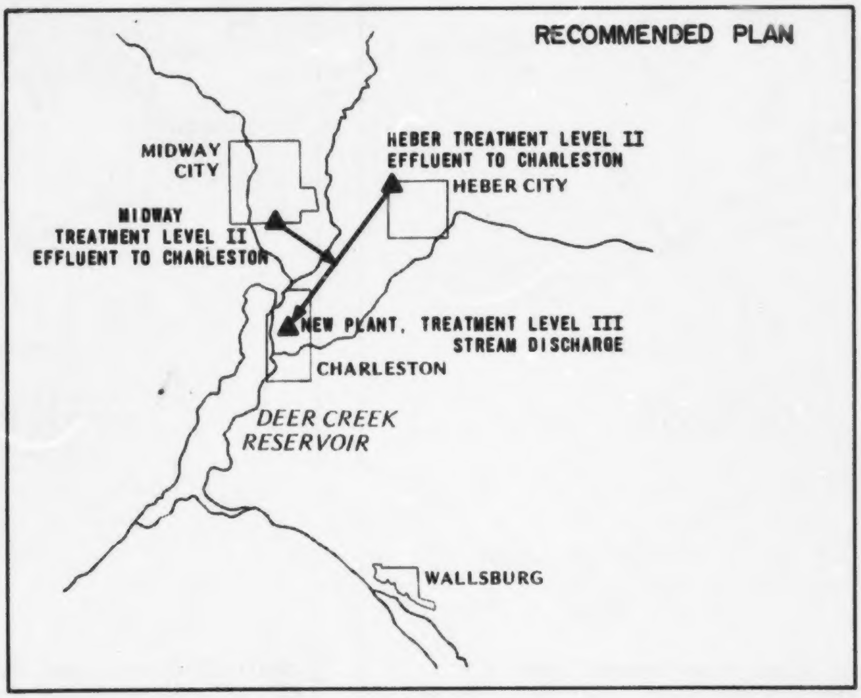
WASTEWATER TREATMENT ALTERNATIVES - WASATCH COUNTY


ALTERNATIVE NO. 5
MIDWAY CITY
HEBER
HEBER CITY
MIDWAY
IV
CHARLESTON
DEER CREEK RESERVOIR
WALLSBURG

CONSTRUCT REGIONAL PLANT SOUTH OF HEBER WITH TREATMENT LEVEL IV; DISCHARGE TO PROVO RIVER ABOVE DEER CREEK RESERVOIR.


ALTERNATIVE NO. 6
MIDWAY CITY
HEBER
HEBER CITY
MIDWAY
CHARLESTON
DEER CREEK RESERVOIR
TO PROVO
WALLSBURG

CONVEY ALL MUNICIPAL SEWAGE OUT OF THE BASIN TO AN EXPANDED PROVO PLANT.


RECOMMENDED PLAN
MIDWAY CITY
HEBER TREATMENT LEVEL II EFFLUENT TO CHARLESTON
HEBER CITY
MIDWAY TREATMENT LEVEL II EFFLUENT TO CHARLESTON
NEW PLANT, TREATMENT LEVEL III STREAM DISCHARGE
CHARLESTON
DEER CREEK RESERVOIR
WALLSBURG

alternatives were considered for consolidation of wastewater management within these areas. These alternatives are presented in Table III-10 and illustrated in Figure III-9.

In Alternatives 1 and 2, all wastewater flows from Northern and Central Utah County would be routed to a new regional facility at Provo and discharged to Provo Bay after treatment; only the level of treatment varies. Alternative 3 is identical to Alternative 2 except ultimate discharge would be to Utah Lake. The Heber Valley area is not considered in Alternatives 1, 2, and 3. Alternatives 4, 5, and 6 consider regional treatment at a new Provo facility of flows from Northern and Central Utah County and from Wasatch County. A Provo Bay discharge is included in Alternatives 4 and 5, whereas Alternative 6 includes a discharge to Utah Lake. Level IV treatment is specified in Alternative 4 and Level III in Alternatives 5 and 6.

The recent plans for upgrading and expansion of the existing Provo facility would seem to preclude further consideration of these alternatives.

Municipal Wastewater Management Alternatives - Southern Utah County and Northern Juab County

For purposes of this Study, Southern Utah County and Northern Juab County include the communities of Santaquin, Goshen, Elberta, Mona, and Nephi. At the present time, only Nephi collects and treats sewage. No alternative wastewater management plans were developed for the area because the communities are small and consolidation and/or conveyance of wastewater out of the area is clearly uneconomical.

The Plan recommends continued use of septic tank systems where feasible and continued use of wastewater lagoons at Nephi.

Other Municipal Wastewater Management Alternatives

Notwithstanding the numerous alternative facility configurations presented and discussed in the foregoing, two other possible wastewater management options were considered for the Study Area. Wastewater reclamation and reuse was summarily dismissed as uneconomical because of the availability of water from other sources, particularly the Central Utah Project. However, it was indicated that future demand for imported water created by future energy development may alter this conclusion. In the event this occurs, many of the physical configurations considered retain the option to go to reclamation and reuse in the future.

Land disposal of treated municipal wastewater was also dismissed from serious consideration except for Alternative 4 for Wasatch County. Reasons offered included the high groundwater table, proximity of treatment plants to developed areas, and the long period of frost. Notwithstanding these valid considerations, the Timpanogos 201 Study is recommending land disposal. Land disposal is being further evaluated within the context of the ongoing 208 Programs.

No Action Alternative

The "no action" alternative was not seriously considered in the Plan nor in this report. Existing water quality problems, significant infiltration in some systems, currently overloaded or near-capacity facilities, and projected significant development are all substantial reasons for implementing some wastewater treatment strategy. Without a minimum of effort to expand and upgrade treatment facilities to secondary treatment levels, existing water quality can be expected to be significantly degraded as a result of future development and population growth.

TABLE III-10

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - OVERALL UTAH AND WASATCH COUNTIES

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge to Utah Lake	Abandon/Connect To
OU/WC-1	Lehi	→	→	→	New Provo - Level IV - Bay
	American Fork	→	→	→	New Provo - Level IV - Bay
	Pleasant Grove	→	→	→	New Provo - Level IV - Bay
	Orem	→	→	→	New Provo - Level IV - Bay
	Provo	→	→	→	New Provo - Level IV - Bay
	Springville	→	→	→	New Provo - Level IV - Bay
	Spanish Fork	→	→	→	New Provo - Level IV - Bay
	Salem	→	→	→	New Provo - Level IV - Bay
	Payson	→	→	→	New Provo - Level IV - Bay
	Midway	Not Considered			
	Heber	Not Considered			
OU/WC-2	Lehi	→	→	→	New Provo - Level III - Bay
	American Fork	→	→	→	New Provo - Level III - Bay
	Pleasant Grove	→	→	→	New Provo - Level III - Bay
	Orem	→	→	→	New Provo - Level III - Bay
	Provo	→	→	→	New Provo - Level III - Bay
	Springville	→	→	→	New Provo - Level III - Bay
	Spanish Fork	→	→	→	New Provo - Level III - Bay
	Salem	→	→	→	New Provo - Level III - Bay
	Payson	→	→	→	New Provo - Level III - Bay
	Midway	Not Considered			
	Heber	Not Considered			

TABLE III-10 (Continued)

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - OVERALL UTAH AND WASATCH COUNTIES

Alternative	Treatment Facility	Treatment Level III	Treatment Level IV	Discharge to Utah Lake	Abandon/Connect To
OU/WC-3	Lehi	→	→	→	New Provo - Level III - Lake
	American Fork	→	→	→	New Provo - Level III - Lake
	Pleasant Grove	→	→	→	New Provo - Level III - Lake
	Orem	→	→	→	New Provo - Level III - Lake
	Provo	→	→	→	New Provo - Level III - Lake
	Springville	→	→	→	New Provo - Level III - Lake
	Spanish Fork	→	→	→	New Provo - Level III - Lake
	Salem	→	→	→	New Provo - Level III - Lake
	Payson	→	→	→	New Provo - Level III - Lake
	Midway	Not Considered			
	Heber	Not Considered			
OU/WC-4	Lehi	→	→	→	New Provo - Level IV - Bay
	American Fork	→	→	→	New Provo - Level IV - Bay
	Pleasant Grove	→	→	→	New Provo - Level IV - Bay
	Orem	→	→	→	New Provo - Level IV - Bay
	Provo	→	→	→	New Provo - Level IV - Bay
	Springville	→	→	→	New Provo - Level IV - Bay
	Spanish Fork	→	→	→	New Provo - Level IV - Bay
	Salem	→	→	→	New Provo - Level IV - Bay
	Payson	→	→	→	New Provo - Level IV - Bay
	Midway	→	→	→	New Provo - Level IV - Bay
	Heber	→	→	→	New Provo - Level IV - Bay

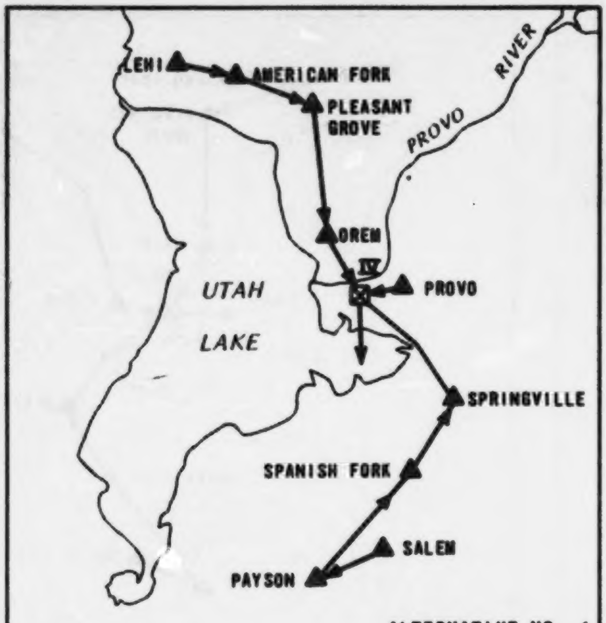
TABLE III-10 (Continued)

MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES - OVERALL UTAH AND WASATCH COUNTIES

Alternative	Treatment Facility	Treatment Level		Discharge to Utah Lake	Abandon/Connect To
		III	IV		
OU/WC-5	Lehi	→	→	→	New Provo - Level III - Bay
	American Fork	→	→	→	New Provo - Level III - Bay
	Pleasant Grove	→	→	→	New Provo - Level III - Bay
	Orem	→	→	→	New Provo - Level III - Bay
	Provo	→	→	→	New Provo - Level III - Bay
	Springville	→	→	→	New Provo - Level III - Bay
	Spanish Fork	→	→	→	New Provo - Level III - Bay
	Salem	→	→	→	New Provo - Level III - Bay
	Payson	→	→	→	New Provo - Level III - Bay
	Midway	→	→	→	New Provo - Level III - Bay
	Heber	→	→	→	New Provo - Level III - Bay
OU/WC-6	Lehi	→	→	→	New Provo - Level III - Lake
	American Fork	→	→	→	New Provo - Level III - Lake
	Pleasant Grove	→	→	→	New Provo - Level III - Lake
	Orem	→	→	→	New Provo - Level III - Lake
	Provo	→	→	→	New Provo - Level III - Lake
	Springville	→	→	→	New Provo - Level III - Lake
	Spanish Fork	→	→	→	New Provo - Level III - Lake
	Salem	→	→	→	New Provo - Level III - Lake
	Payson	→	→	→	New Provo - Level III - Lake
	Midway	→	→	→	New Provo - Level III - Lake
	Heber	→	→	→	New Provo - Level III - Lake

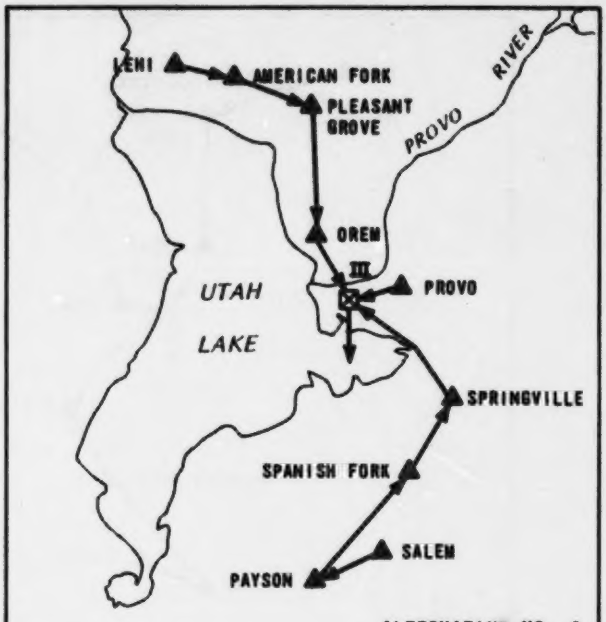
FIGURE III-9

WASTEWATER TREATMENT ALTERNATIVES
OVERALL UTAH AND WASATCH COUNTIES


LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
OREM
IV
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
SALEM
PAYSON

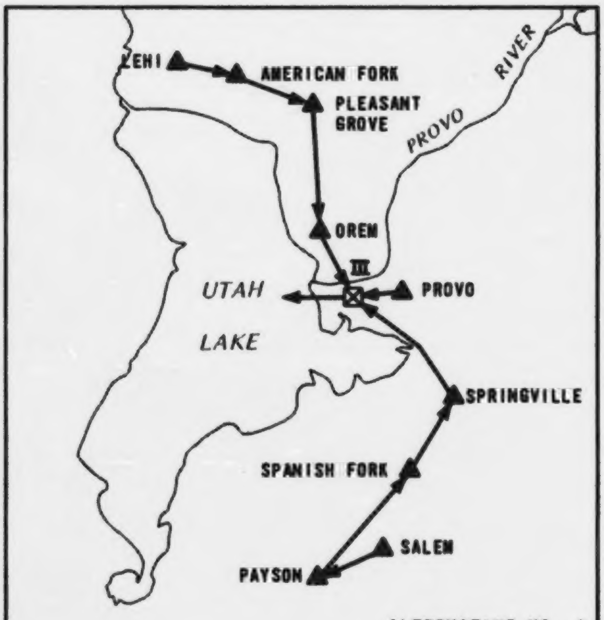
ALTERNATIVE NO. 1

CONVEY ALL FLOWS FROM NORTHERN AND CENTRAL UTAH COUNTY NEW REGIONAL PLANT NEAR PROVO. LEVEL IV TREATMENT AND DISCHARGE TO PROVO BAY


LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
OREM
III
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
SALEM
PAYSON

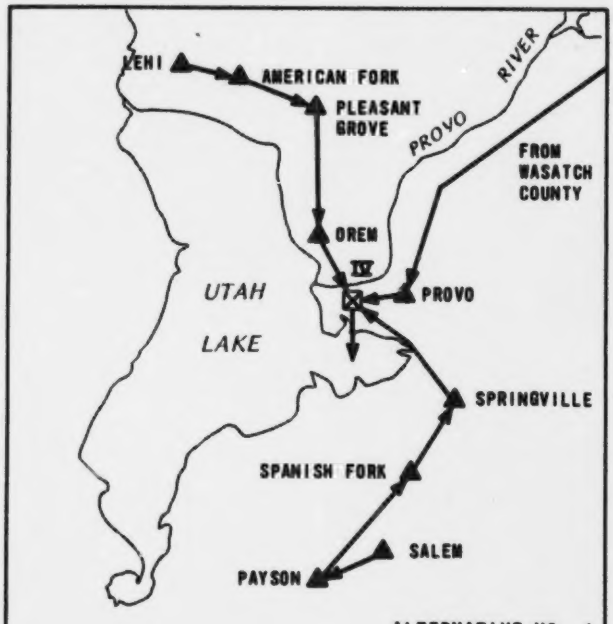
ALTERNATIVE NO. 2

AS ALTERNATIVE 1, BUT WITH LEVEL III TREATMENT.


LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
OREM
III
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
SALEM
PAYSON

ALTERNATIVE NO. 3

AS ALTERNATIVE 1, BUT WITH LEVEL III TREATMENT. CONSTRUCT OUTFALL TO UTAH LAKE.

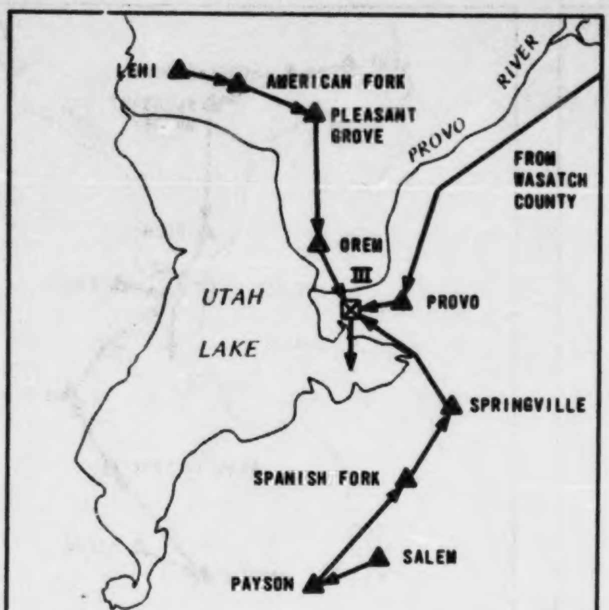

LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
FROM WASATCH COUNTY
OREM
IV
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
SALEM
PAYSON

ALTERNATIVE NO. 4

AS ALTERNATIVE 1, BUT INCLUDING ALL FLOWS FROM WASATCH COUNTY.

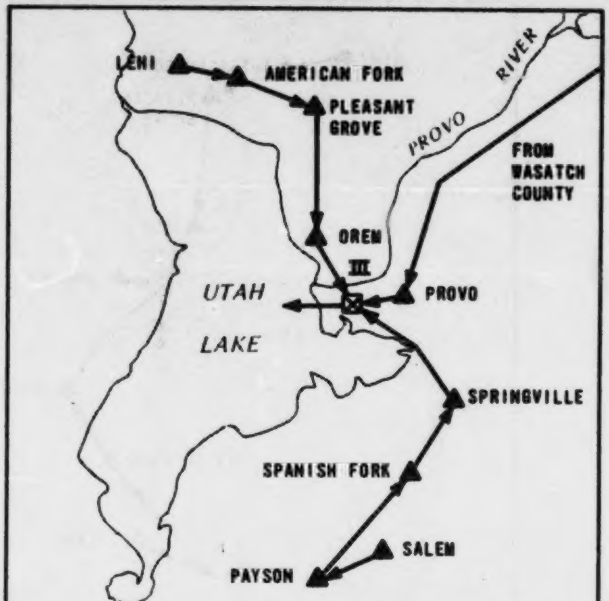
FIGURE III-9 (Continued)

WASTEWATER TREATMENT ALTERNATIVES
OVERALL UTAH AND WASATCH COUNTIES


LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
FROM WASATCH COUNTY
OREM
III
UTAH LAKE
PROVO
SPRINGVILLE
SPANISH FORK
SALEM
PAYSON

ALTERNATIVE NO. 5

AS ALTERNATIVE 2, BUT INCLUDING ALL FLOWS FROM WASATCH COUNTY.


LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
FROM WASATCH COUNTY
OREM
III
UTAH LAKE
PROVO
SPRINGVILLE
SPANISH FORK
SALEM
PAYSON

ALTERNATIVE NO. 6

AS ALTERNATIVE 3, BUT INCLUDING ALL FLOWS FROM WASATCH COUNTY

CHAPTER IV

WATER QUALITY IMPACTS

INTRODUCTION

As discussed in Chapter III, the Study Area was divided into planning areas for purposes of estimating wastewater loads and treatment needs. Alternative wastewater management strategies were then developed for aggregations of these planning areas and treatment plants. Seven sub-basin areas were defined and the alternatives for each discussed in Chapter III. These sub-basin areas and associated treatment plants are:

- Davis County (DC) comprised of the North Davis, Central Davis, and South Davis Planning Areas served by the following treatment plants:
  - North Davis
  - Central Davis
  - South Davis North
  - South Davis South
- Salt Lake County (SLC) comprised of the Salt Lake City, South Salt Lake, Murray-Cottonwood, and Tri-Community/Sandy Planning Areas served by the following treatment plants:
  - Salt Lake City
  - South Salt Lake
  - Granger-Hunter
  - Salt Lake City Suburban Sanitation District No. 1
  - Murray
  - Salt Lake County - Cottonwood
  - Tri-Community
  - Sandy
- Magna Area (MA) consisting of the Magna Planning Area served by the Magna wastewater treatment facility.
- Northern Utah County (NUC) consisting of the American Fork Planning Area served by the following treatment plants:
  - Lehi
  - American Fork
  - Pleasant Grove
  - Orem
- Central Utah County (CUC) comprised of the Provo, Springville, Spanish Fork, and Payson Planning Areas served by the following wastewater treatment plants:
  - Provo
  - Springville
  - Spanish Fork
  - Salem
  - Payson
- Wasatch County (WC) consisting of the Heber Valley Planning Area served by the Heber and Midway treatment plants.
- Overall Utah and Wasatch Counties (OU/WC) comprised of the planning areas for Northern Utah County, Central Utah County, and Wasatch County and served by the wastewater treatment facilities in each area. These alternatives are not discussed

herein because of the commitments being made for upgrading and expanding the Provo wastewater treatment facility as discussed in Chapter III.

The water quality impacts associated with the sub-area alternatives are analyzed in terms of the economics, waste load reductions, and impacts on aquatic ecology. Economic impacts are defined in terms of the total 1973 capital (construction) costs, annual operation and maintenance costs, and the total annual cost per person connected to each system. Total annual costs were derived by amortizing the capital cost of treatment facilities at seven percent for 20 years and the capital cost of interceptors at seven percent for 60 years and adding annual operation and maintenance cost. Total annual costs were then divided by the median population between existing conditions and the 1995 projections for each facility as presented in Table IV-1. The resultant annual cost per capita is intended to reflect an "average" cost over the life of the facility and does not reflect "actual" cost per capita, nor does this value recognize the potential for 75 percent Federal funding for capital cost.

Estimates of waste load reductions are made for each sub-area with the exception of Salt Lake County where mathematical modelling efforts make in place water quality evaluation possible. Waste load reductions are derived by estimating the non-point (runoff) and point (wastewater treatment plant and industrial effluents) pollutant loadings for Biochemical Oxygen Demand (BOD), Total Dissolved Solids (TDS), Total Nitrogen (TN), Phosphates (PO_4), and Total Suspended Solids (TSS) in each sub-area (see Chapter II for an explanation of these parameters). The point source loadings were estimated by converting the estimated flows to pounds of parameter discharged using the estimated effluent concentrations presented in Table III-4. Non-point source loadings were estimated by multiplying the future land use areas in acres by average parameter loading coefficients expressed in pounds per acre per year. These coefficients were developed from local data and data from similar areas where local data was missing. The potential effects of non-point source controls, as being currently investigated by the 208 Programs, are not considered in these estimated non-point loadings. This approach was taken because it is impossible to tell what types of non-point controls are feasible at this time and what their effect might be.

The impacts of the aquatic ecology of each area are evaluated in terms of the identified species in each area. Because of the impossibility of assessing in place water quality, these impacts are more qualitative than quantitative.

The water quality impacts of all physical system alternatives for each sub-area are presented in the following sections. A general discussion of the legal implications follows these sub-area presentations.

The following analysis does not include a discussion of coliform loadings nor ammonia loadings. These two parameters are important to any evaluation of water quality impacts but the lack of any coliform or ammonia data for non-point sources precludes any analysis. Suffice it to say that the effluent criteria for total coliforms specified for Level III and Level IV treatment, 2.2 MPN/100 ml, and the inclusion of nitrification in the unit processes for these treatment levels will act to reduce coliform and ammonia levels from point discharges in the future.

DAVIS COUNTY

The wastewater treatment facilities alternatives for Davis County are illustrated in Figure IV-1. For purposes of evaluation, the alternatives have been aggregated into three categories:

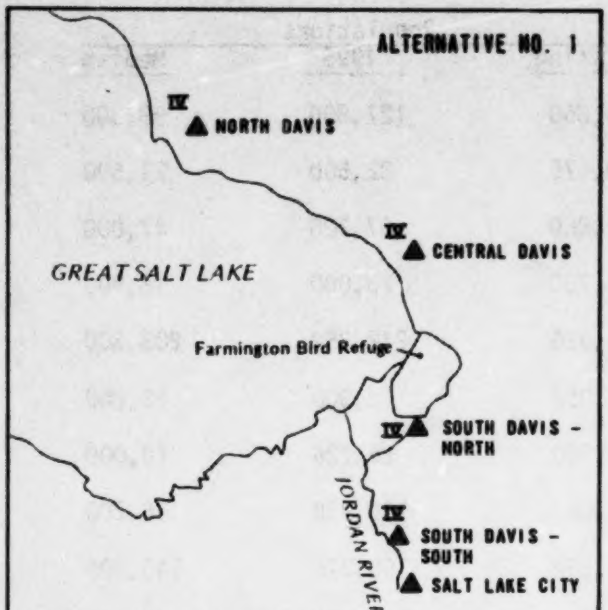
TABLE IV-1

EXISTING, 1995, AND MEDIAN POPULATIONS

Facility	Populations Existing	1995	Median
North Davis	70,850	127,800	99,300
Central Davis	10,675	32,500	21,600
South Davis North	37,860	57,700	47,800
South Davis South	14,730	23,000	18,900
Salt Lake City	175,320	242,350	208,800
Magna	7,052	18,500	12,800
South Salt Lake	9,300	26,726	18,000
Granger-Hunter	72,583	119,755	96,200
SLC - SSD #1	120,352	160,326	140,300
Cottonwood	48,561	77,462	63,000
Murray	24,980	48,000	36,500
Tri-Community	30,000	47,700	38,800
Sandy	20,113	26,682	23,400
Lehi	4,800	8,179	6,500
American Fork	11,000	12,759	11,900
Pleasant Grove	6,000	8,328	7,200
Orem	28,400	63,521	46,000
Heber	3,050	6,700	4,900
Midway	1,095	2,215	1,700
Provo	63,500	78,689	71,100
Springville	8,400	18,893	13,600
Spanish Fork	7,700	12,970	10,300
Salem	1,200	1,661	1,400
Payson	5,180	6,889	6,000

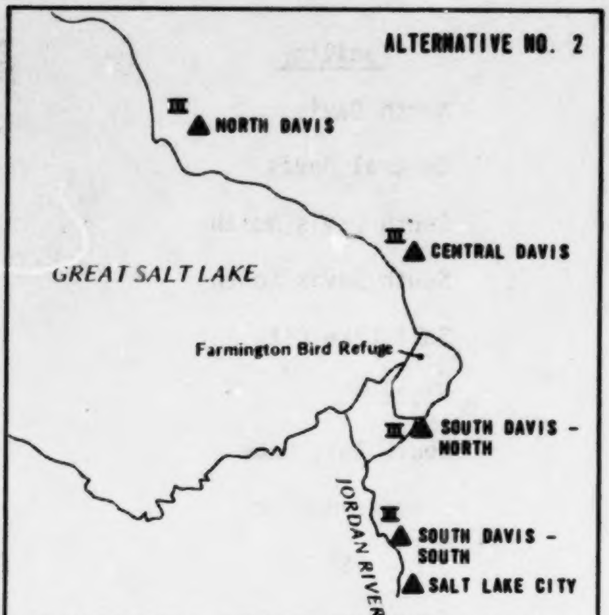
FIGURE IV-1

WASTEWATER TREATMENT ALTERNATIVES - DAVIS COUNTY


ALTERNATIVE NO. 1

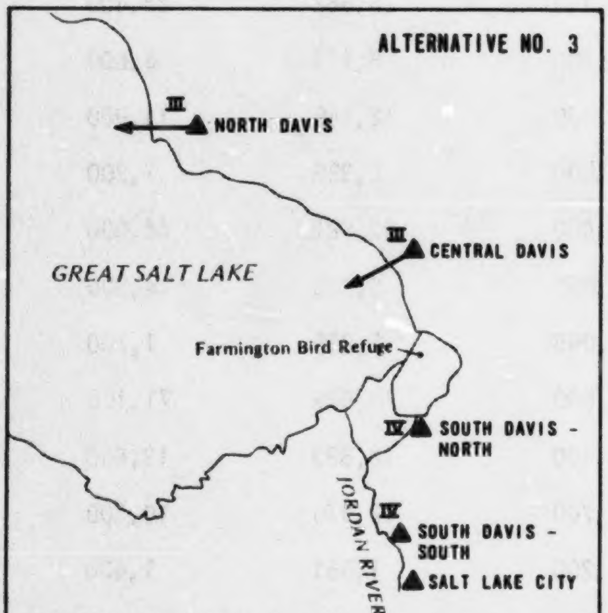
IV
NORTH DAVIS
IV
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
IV
SOUTH DAVIS - NORTH
JORDAN RIVER
IV
SOUTH DAVIS - SOUTH
SALT LAKE CITY

MODIFY AND EXPAND EXISTING TREATMENT PLANTS AT EXISTING LOCATIONS. LEVEL IV TREATMENT AT ALL PLANTS.


ALTERNATIVE NO. 2

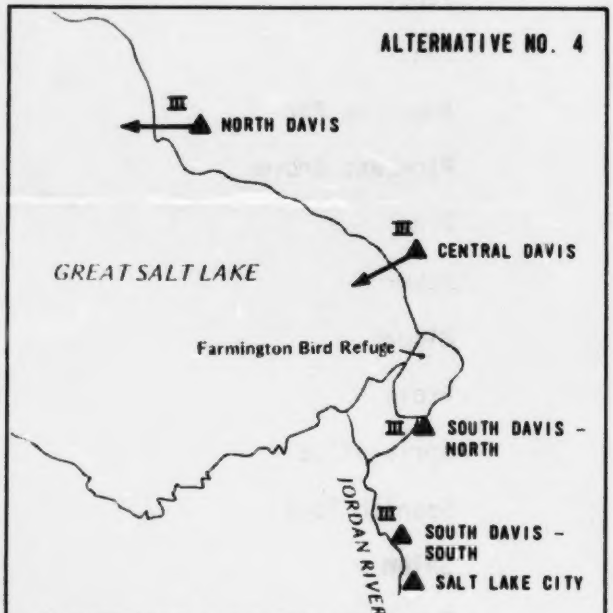
III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
III
SOUTH DAVIS - NORTH
JORDAN RIVER
III
SOUTH DAVIS - SOUTH
SALT LAKE CITY

AS ALTERNATIVE 1, BUT LEVEL III TREATMENT AT ALL PLANTS.


ALTERNATIVE NO. 3

III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
IV
SOUTH DAVIS - NORTH
JORDAN RIVER
IV
SOUTH DAVIS - SOUTH
SALT LAKE CITY

MODIFY AND EXPAND EXISTING TREATMENT PLANTS AT EXISTING LOCATIONS. CONSTRUCT LAKE OUTFALLS AT NORTH AND CENTRAL DAVIS. LEVEL III TREATMENT AT NORTH AND CENTRAL DAVIS; LEVEL IV TREATMENT AT SOUTH DAVIS NORTH AND SOUTH.

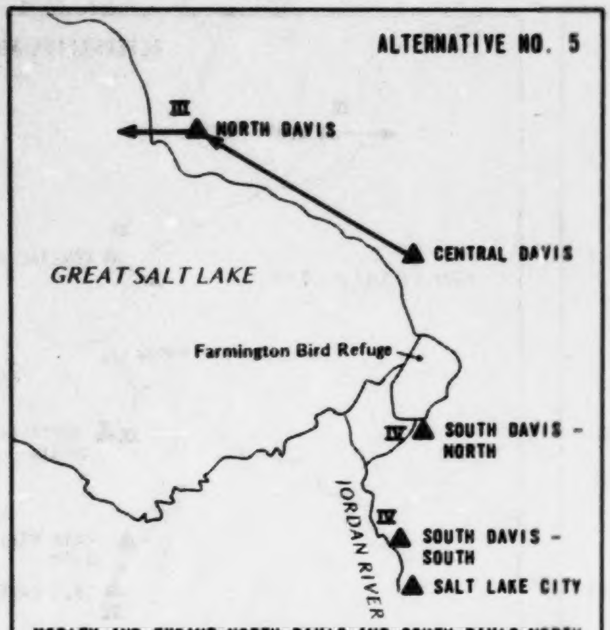

ALTERNATIVE NO. 4

III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
III
SOUTH DAVIS - NORTH
JORDAN RIVER
III
SOUTH DAVIS - SOUTH
SALT LAKE CITY

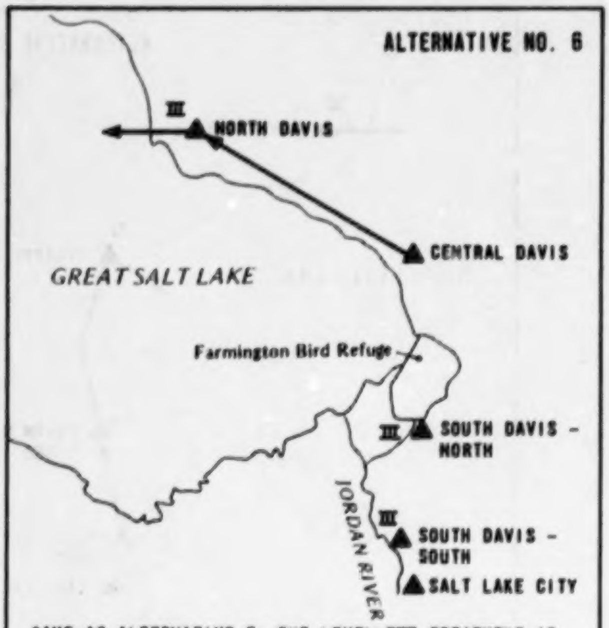
AS ALTERNATIVE 3, BUT LEVEL III TREATMENT AT SOUTH DAVIS NORTH AND SOUTH.

FIGURE IV-1 (Continued)

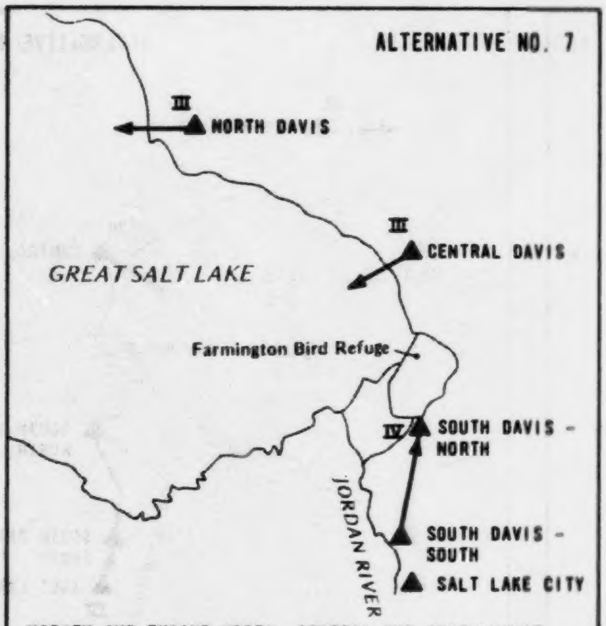
WASTEWATER TREATMENT ALTERNATIVES - DAVIS COUNTY


ALTERNATIVE NO. 5
III
NORTH DAVIS
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
IV
SOUTH DAVIS - NORTH
JORDAN RIVER
IV
SOUTH DAVIS - SOUTH
SALT LAKE CITY

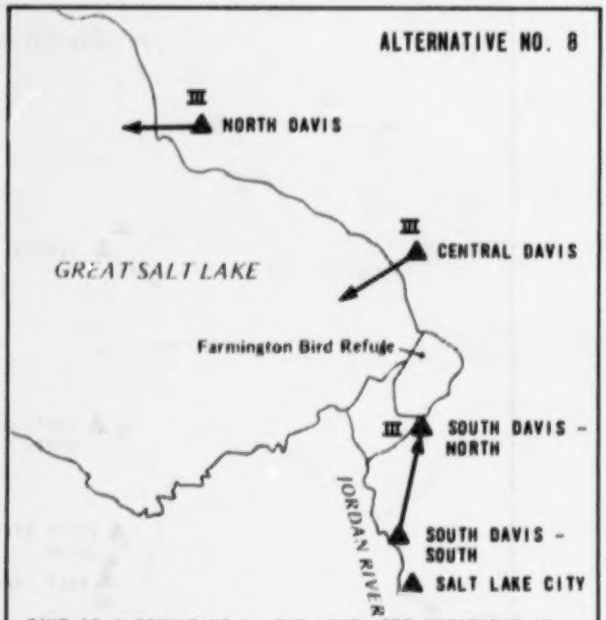
MODIFY AND EXPAND NORTH DAVIS AND SOUTH DAVIS NORTH AND SOUTH PLANTS. ABANDON CENTRAL DAVIS, CONVEY FLOWS TO NORTH DAVIS. CONSTRUCT LAKE OUTFALL AT NORTH DAVIS. TREATMENT LEVEL III AT NORTH DAVIS; TREATMENT LEVEL IV AT SOUTH DAVIS NORTH AND SOUTH.


ALTERNATIVE NO. 6
III
NORTH DAVIS
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
III
SOUTH DAVIS - NORTH
JORDAN RIVER
III
SOUTH DAVIS - SOUTH
SALT LAKE CITY

SAME AS ALTERNATIVE 5, BUT LEVEL III TREATMENT AT SOUTH DAVIS NORTH AND SOUTH.


ALTERNATIVE NO. 7
III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
IV
SOUTH DAVIS - NORTH
JORDAN RIVER
SOUTH DAVIS - SOUTH
SALT LAKE CITY

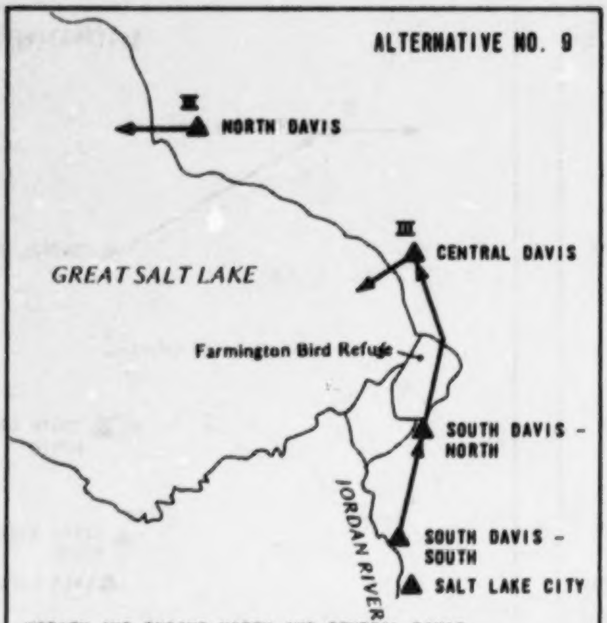
MODIFY AND EXPAND NORTH, CENTRAL AND SOUTH DAVIS NORTH. ABANDON SOUTH DAVIS SOUTH, CONVEY FLOWS TO SOUTH DAVIS NORTH. CONSTRUCT LAKE OUTFALLS AT NORTH AND CENTRAL DAVIS. TREATMENT LEVEL III AT NORTH AND CENTRAL DAVIS. TREATMENT LEVEL IV AT SOUTH DAVIS NORTH.


ALTERNATIVE NO. 8
III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
III
SOUTH DAVIS - NORTH
JORDAN RIVER
SOUTH DAVIS - SOUTH
SALT LAKE CITY

SAME AS ALTERNATIVE 7, BUT LEVEL III TREATMENT AT SOUTH DAVIS NORTH.

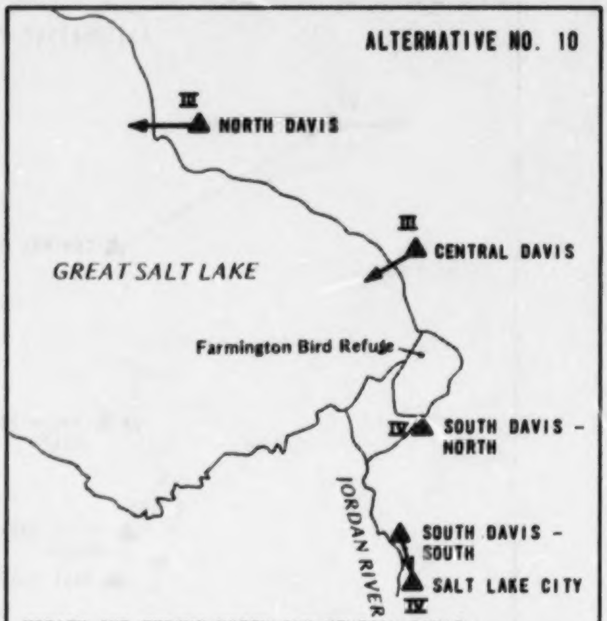
FIGURE IV-1 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - DAVIS COUNTY


ALTERNATIVE NO. 9

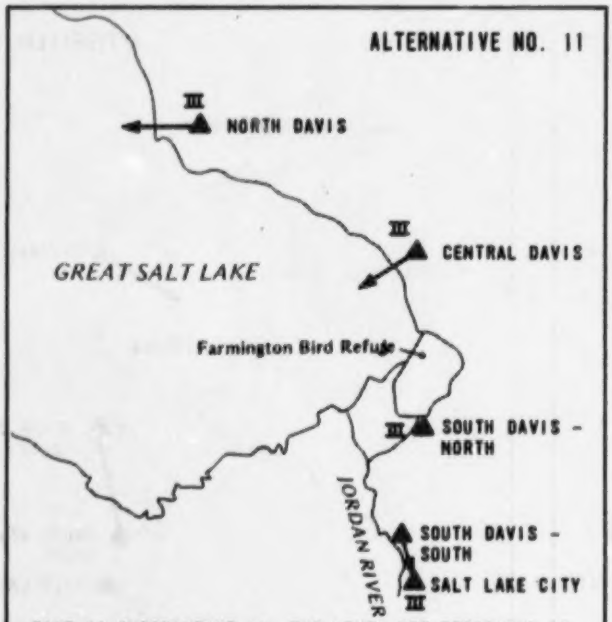
III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
SOUTH DAVIS - NORTH
JORDAN RIVER
SOUTH DAVIS - SOUTH
SALT LAKE CITY

MODIFY AND EXPAND NORTH AND CENTRAL DAVIS. CONSTRUCT LAKE OUTFALLS AT NORTH AND CENTRAL DAVIS. LEVEL III TREATMENT. ABANDON SOUTH DAVIS SOUTH AND SOUTH DAVIS NORTH. CONVEY FLOWS TO CENTRAL DAVIS.


ALTERNATIVE NO. 10

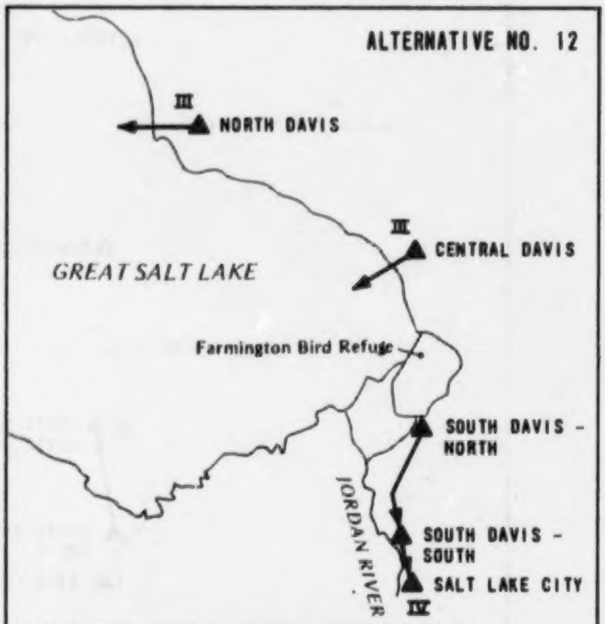
III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
IV
SOUTH DAVIS - NORTH
JORDAN RIVER
SOUTH DAVIS - SOUTH
SALT LAKE CITY
IV

MODIFY AND EXPAND NORTH AND CENTRAL DAVIS. CONSTRUCT LAKE OUTFALLS AT NORTH AND CENTRAL DAVIS. LEVEL III TREATMENT. LEVEL IV TREATMENT AT SOUTH DAVIS NORTH. ABANDON SOUTH DAVIS SOUTH. CONVEY FLOWS TO SALT LAKE CITY. TREATMENT LEVEL IV.


ALTERNATIVE NO. 11

III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
III
SOUTH DAVIS - NORTH
JORDAN RIVER
SOUTH DAVIS - SOUTH
SALT LAKE CITY
III

SAME AS ALTERNATIVE 10, BUT LEVEL III TREATMENT AT SOUTH DAVIS NORTH AND SALT LAKE CITY.

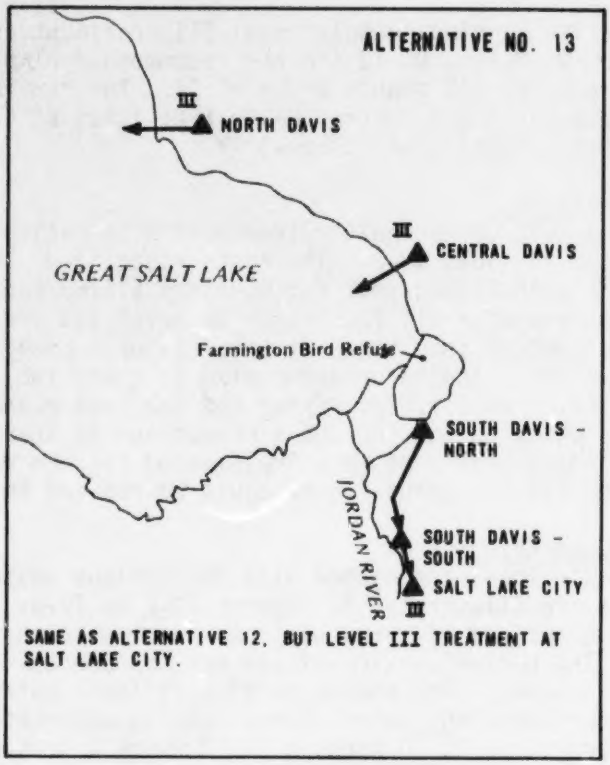

ALTERNATIVE NO. 12

III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
SOUTH DAVIS - NORTH
JORDAN RIVER
SOUTH DAVIS - SOUTH
SALT LAKE CITY
IV

MODIFY AND EXPAND NORTH AND CENTRAL DAVIS. CONSTRUCT LAKE OUTFALLS AT NORTH AND CENTRAL DAVIS. LEVEL III TREATMENT. ABANDON SOUTH DAVIS NORTH AND SOUTH DAVIS SOUTH. CONVEY FLOWS TO SALT LAKE CITY. TREATMENT LEVEL IV.

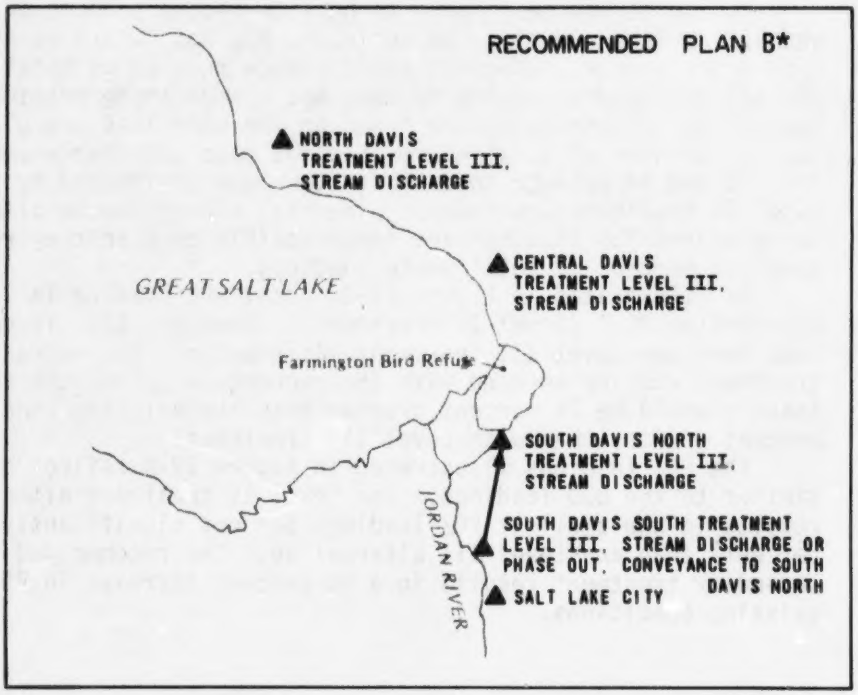
FIGURE IV-1 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - DAVIS COUNTY


ALTERNATIVE NO. 13

III
NORTH DAVIS
III
CENTRAL DAVIS
GREAT SALT LAKE
Farmington Bird Refuge
SOUTH DAVIS - NORTH
JORDAN RIVER
SOUTH DAVIS - SOUTH
SALT LAKE CITY
III

SAME AS ALTERNATIVE 12, BUT LEVEL III TREATMENT AT SALT LAKE CITY.


RECOMMENDED PLAN B*

NORTH DAVIS
TREATMENT LEVEL III,
STREAM DISCHARGE
CENTRAL DAVIS
TREATMENT LEVEL III,
STREAM DISCHARGE
GREAT SALT LAKE
Farmington Bird Refuge
SOUTH DAVIS NORTH
TREATMENT LEVEL III,
STREAM DISCHARGE
JORDAN RIVER
SOUTH DAVIS SOUTH TREATMENT
LEVEL III, STREAM DISCHARGE OR
PHASE OUT, CONVEYANCE TO SOUTH
DAVIS NORTH
SALT LAKE CITY

*RECOMMENDED PLAN A IS SHOWN AS ALTERNATIVE DC-2

- all plants at Level III treatment
- all plants at Level IV treatment
- a combination of Level III and Level IV treatment plants.

Alternatives including only Level III treatment are DC-2, DC-4, DC-6, DC-8, DC-9, DC-11, DC-13 and the recommended plan. Only one alternative, DC-1, requires all plants at Level IV. The remaining alternatives include the North Davis and Central Davis facilities at Level III and the two South Davis facilities at Level IV.

Cost Analysis

The cost of wastewater treatment alternatives for Davis County are presented in Table IV-2. The costs associated with these alternatives range from $8.55/cap/year for DC-13 to $16.63/cap/year for DC-5. The alternatives with all facilities at Level III treatment are generally more economical than those at Level IV or a combination of Level III and Level IV. The recommended plan is among the more economical of alternatives at $10.87/cap/year and the most economical of all the alternatives which do not include a connection to the Salt Lake City Plant. If secondary treatment were implemented for the recommended plan instead of Level III treatment, costs could be reduced to $4.21/cap/year.

Waste Load Analysis

Waste loads associated with the various wastewater treatment alternatives are illustrated in Figures IV-2 to IV-6. Each bar on the figures can be comprised of three sections summing to the total estimated waste load. The bottom portion of the bar represents the anticipated non-point source loading. The middle portion reflects point sources and the top area represents any point source loading exported to another area such as alternatives DC-10 through DC-13 where a portion of the waste load is transported to the Salt Lake City plant.

Non-point sources appear to be significant sources of BOD, TSS, and TDS in Davis County. In contrast, PO_4 and TN are derived mostly from point sources. The non-point source portion of total waste loadings for all parameters considered does not change among treatment alternatives because all alternatives are based on the same land use plan. The point sources portion of total waste loadings does not change among alternatives for TDS and TN because these parameters are unaffected by Level III and Level IV treatment processes. Likewise, changes among alternatives in point source TSS loadings are imperceptible because they represent less than one percent of total waste loadings.

As illustrated in Figure IV-2, total BOD loading is least for Alternative DC-1 (Level IV treatment). However, this is only 15 percent less than any Level III treatment alternative. In contrast, if secondary treatment was implemented with the recommended plan, the future BOD loading would be 75 percent greater than the existing condition and 53 percent greater than with Level III treatment.

The PO_4 loadings illustrated in Figure IV-4 reflect characteristics similar to the BOD loadings. The Level IV treatment alternative, DC-1, results in the smallest PO_4 loading, but not significantly less (12 percent) than any Level III alternative. The recommended plan with secondary treatment results in a 60 percent increase in PO_4 loading over existing conditions.

TABLE IV-2

COST ANALYSIS FOR DAVIS COUNTY

Categories of Alternatives	Capital Cost ($\$10^6$)	Annual Operation & Maintenance Cost ($\$10^6$/Yr)	Annual Cost Per Capita ($/Cap/Yr)
Level III Alternatives			
DC-2 (Recommended Plan A)	9.55	1.17	11.14
DC-4	14.24	1.19	13.01
DC-6	16.31	1.05	13.11
DC-8	15.04	1.09	12.74
DC-9	19.79	1.01	14.07
DC-11	19.22	1.85	8.96
DC-13	19.18	1.74	8.55
Level IV Alternatives			
DC-1	23.77	1.74	21.22
Levels III & IV Alternatives			
DC-3	19.39	1.37	16.52
DC-5	21.46	1.23	16.63
DC-7	19.74	1.26	15.99
DC-10	33.75	2.59	14.25
DC-12	32.18	2.49	13.55
Recommended Plan B			
Level III	10.35	1.07	10.87
Secondary	3.22	0.51	4.21

FIGURE IV-2

BOD WASTE LOADS - DAVIS COUNTY

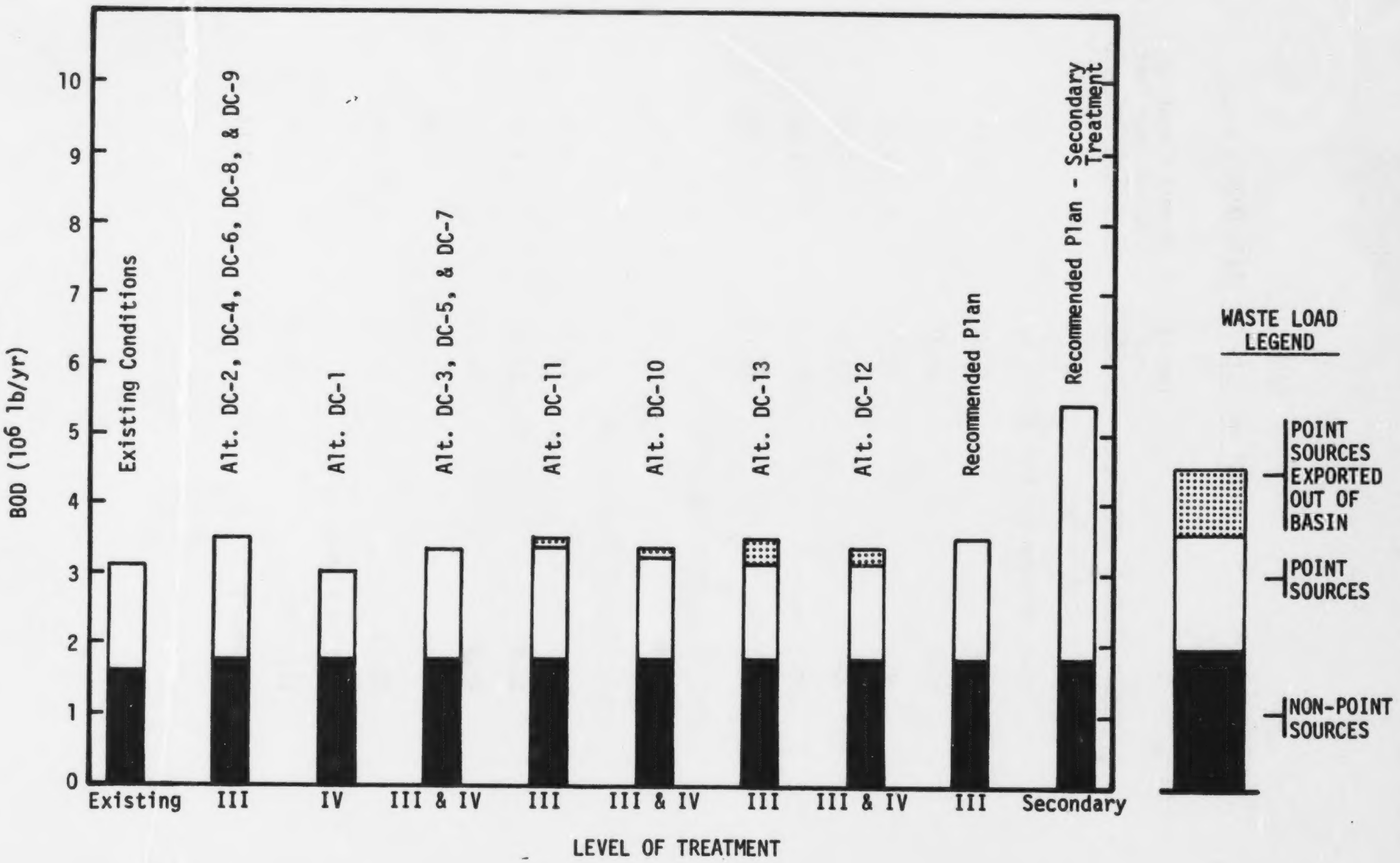


FIGURE IV-3

TDS WASTE LOADS - DAVIS COUNTY

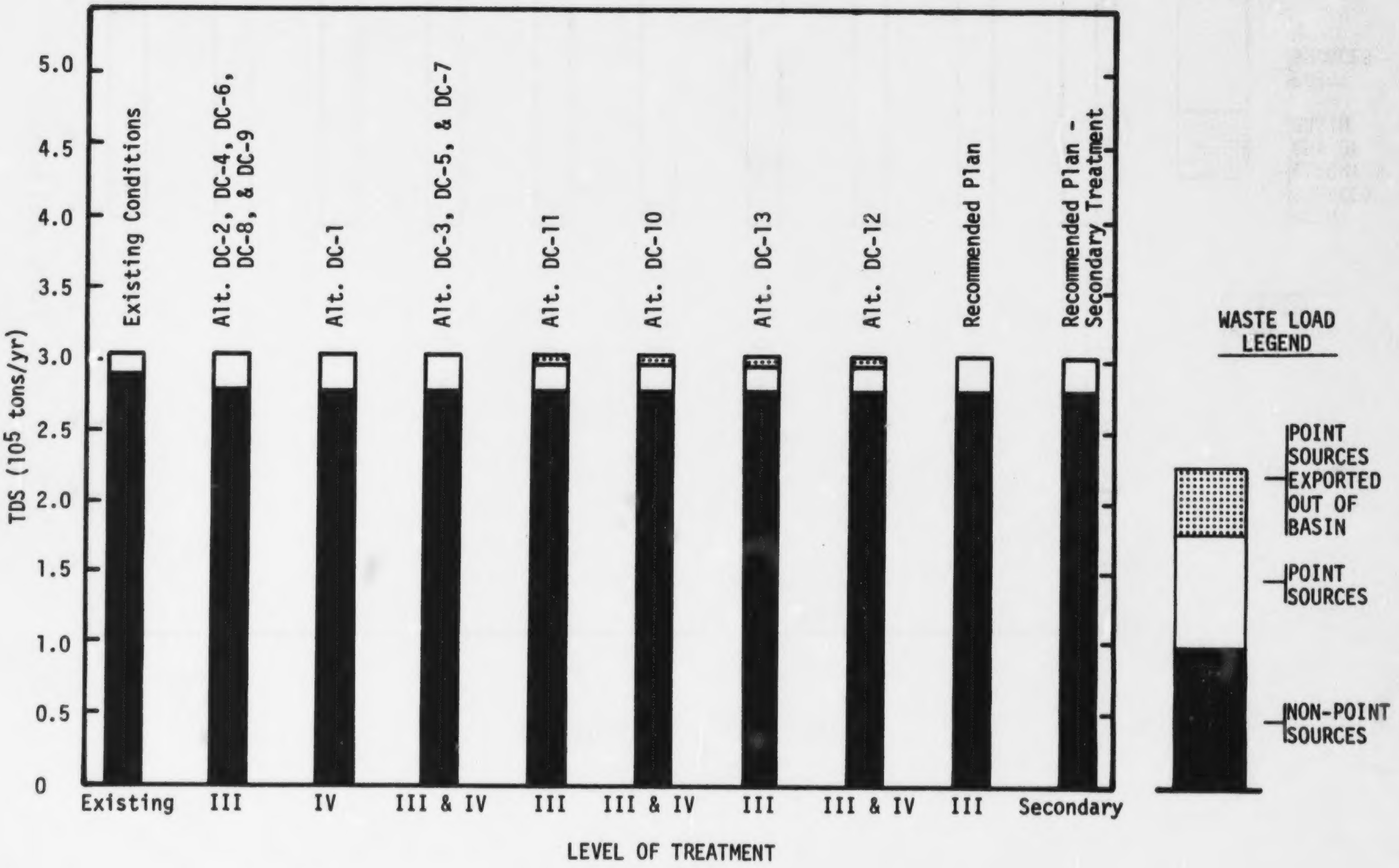


FIGURE IV-4

TN WASTE LOADS - DAVIS COUNTY

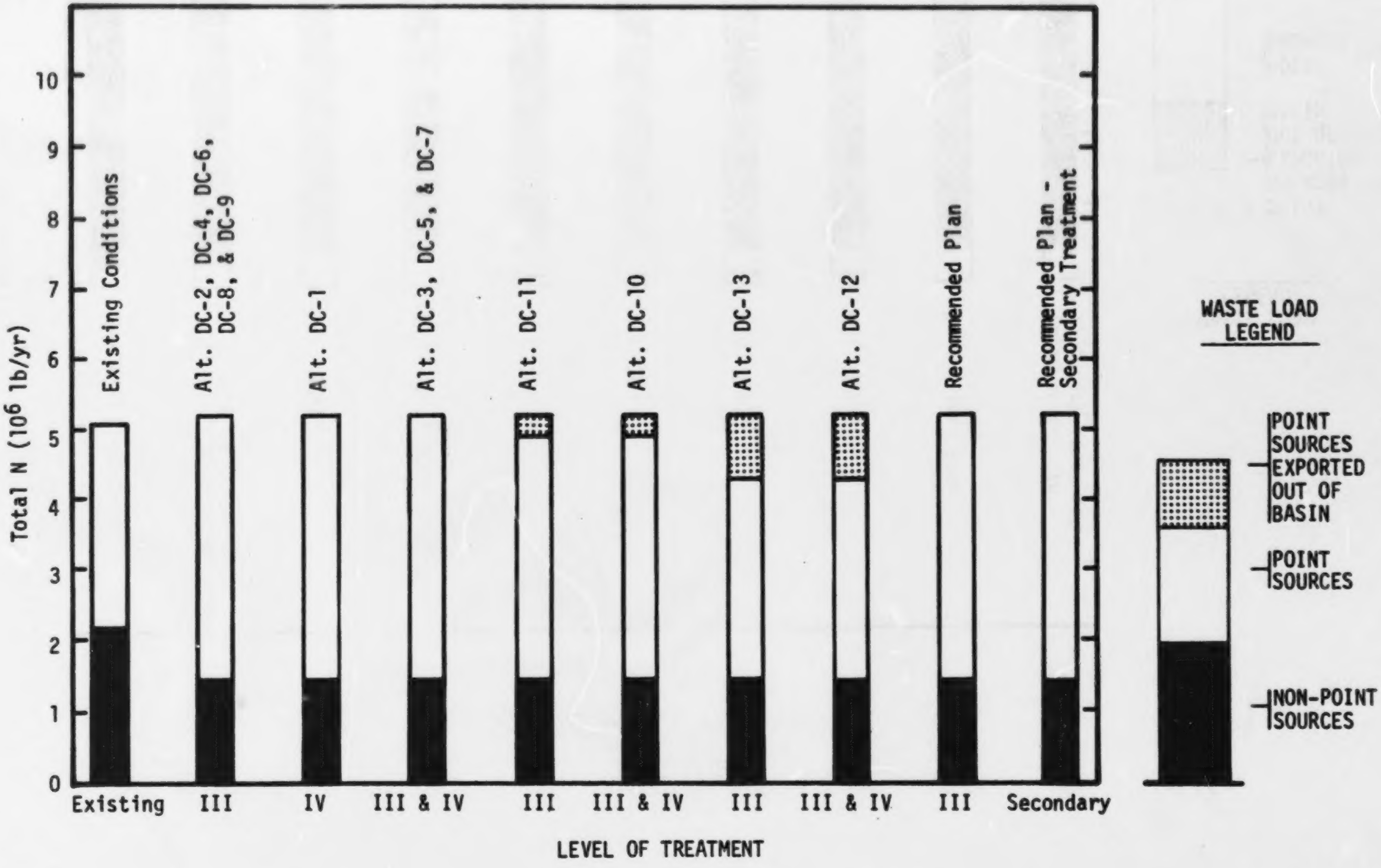


FIGURE IV-5

PO_4 WASTE LOADS - DAVIS COUNTY

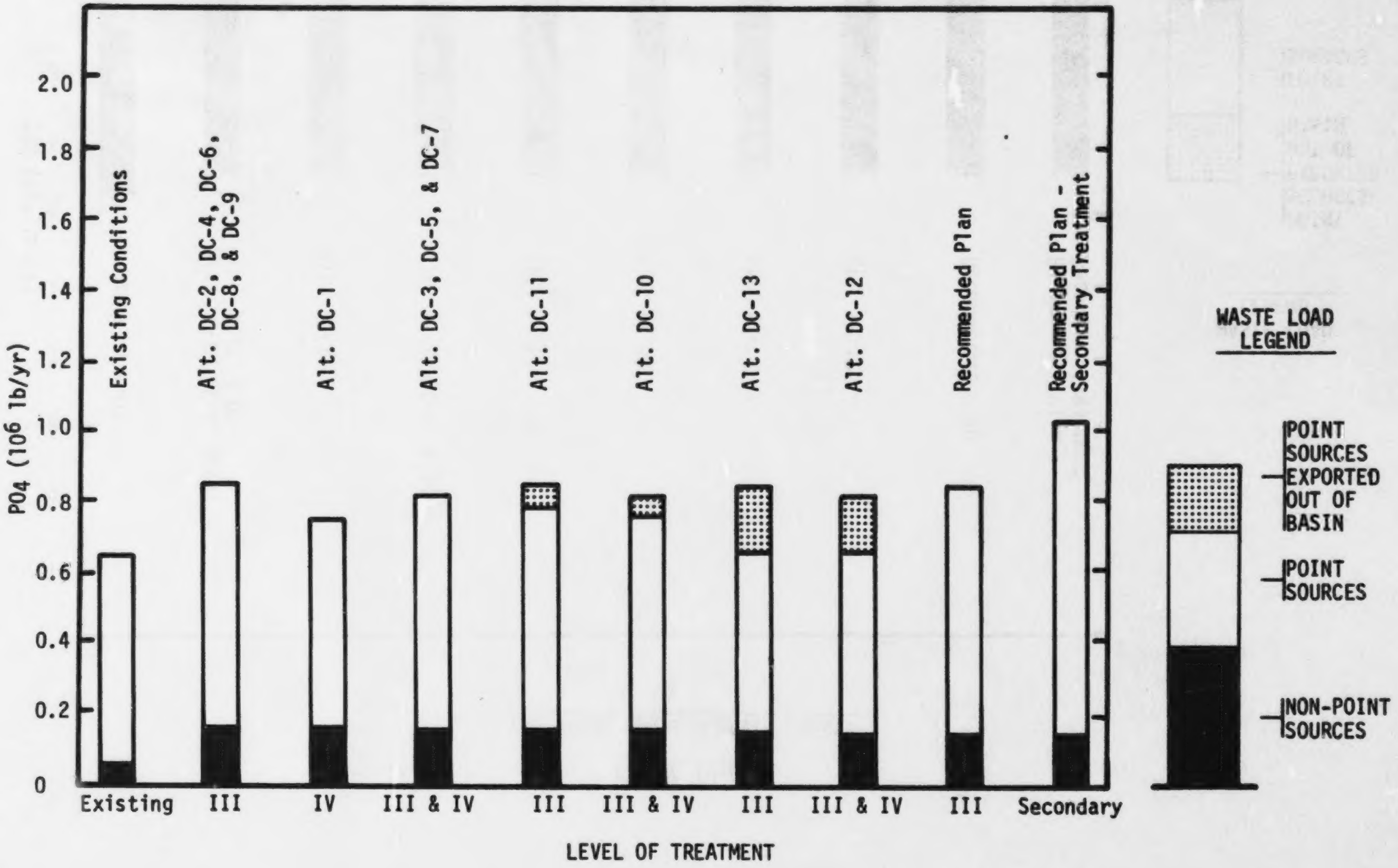
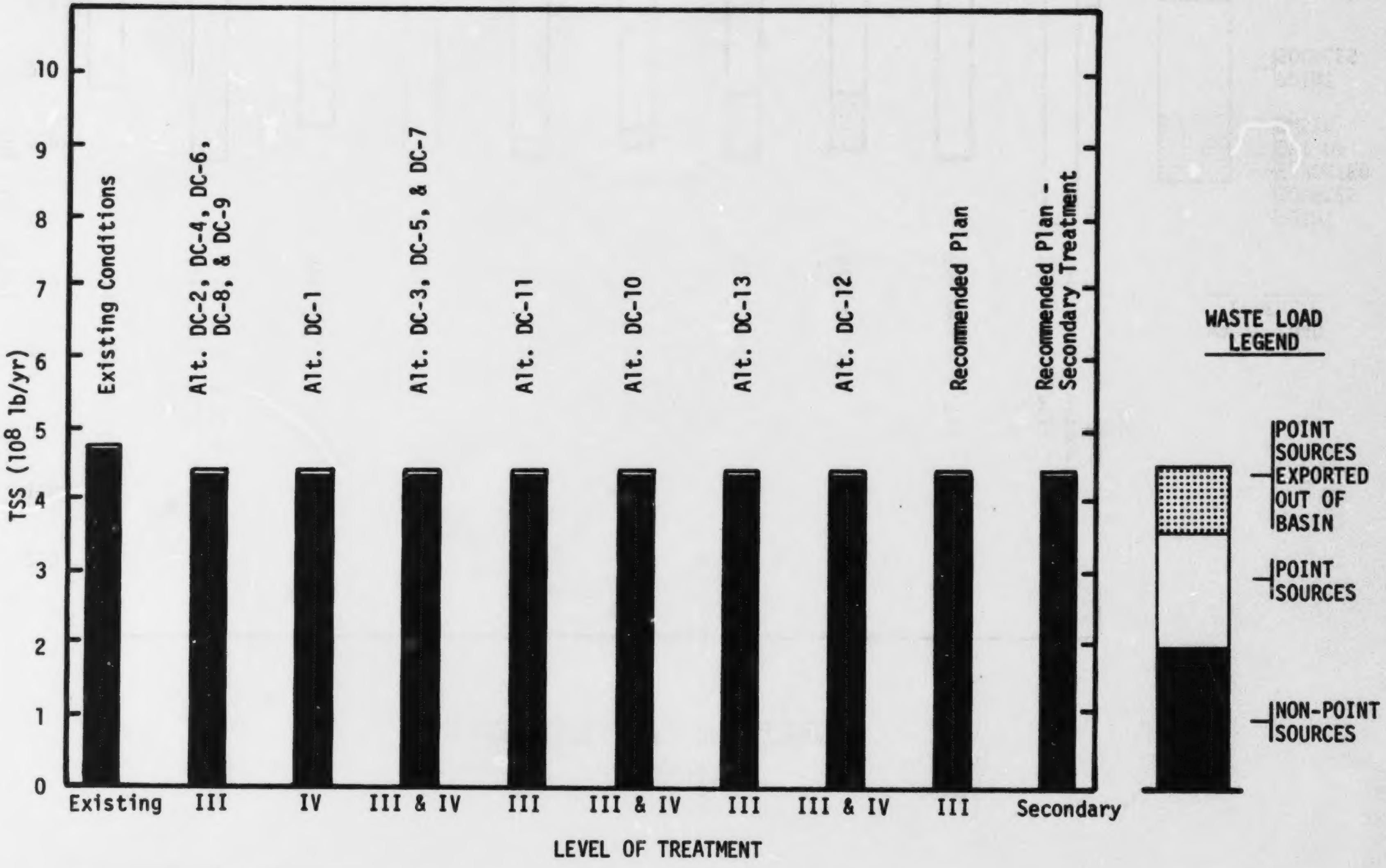


FIGURE IV-6

TSS WASTE LOADS - DAVIS COUNTY



Coliform bacteria loadings are not illustrated, but any alternative can be expected to reduce bacterial contamination from point sources over existing conditions because of strict effluent limitations on coliform bacteria for all levels of treatment considered. See Table III-4 for a comparison of estimated coliform effluent quality for secondary, Level III, and Level IV treatment levels.

Aquatic Impact

The ultimate receiving environment for Davis County wastewater treatment plant effluents is Farmington Bay and Great Salt Lake. The extremely saline environment of Great Salt Lake limits aquatic life to protozoa, brine shrimp, eleven species of bacteria, and four species of algae. A direct effect of Great Salt Lake's high salinity content is to kill most bacteria hence reducing the potential for oxygen depletion and health hazards. Additionally, there is a limited algal population to assimilate nutrients, thus aesthetic problems associated with algal blooms and subsequent oxygen depletion may be limited.

Natural wave action in Great Salt Lake has created a sand barrier which effectively cuts off Farmington Bay from the remainder of the Lake. This situation and the limited current information available to describe this unique aquatic ecosystem and its behavior to wastewater discharges makes further quantitative evaluation of ecosystem impact impossible. This issue is currently being studied by the ongoing 208 Programs.

Summary

Based on the previous discussion regarding costs, waste loads, and aquatic impacts resulting from the Davis County wastewater treatment strategies, the following observations can be made:

- At Level III treatment, Alternative DC-13 is the most economical facility plan.
- Ignoring the cost of the Salt Lake City facility, at combined Level III and Level IV treatment, Alternative DC-12 is least expensive.
- The recommended plan with secondary treatment has an associated cost of only 40 percent of the recommended plan at Level III.
- Non-point sources create significant BOD, TSS, and TDS waste loads.
- No reduction in TDS, TN, or TSS will occur as a result of advanced treatment (Level III or IV) because TDS and TN are unaffected by treatment level and point source TSS loadings represent less than one percent of total TSS loadings.
- No significant reduction in BOD or PO_4 results as one goes from Level III to Level IV treatment.
- Because of the extremely saline nature of the Great Salt Lake, it is possible that no significant impact, either detrimental or beneficial, may be expected from discharging wastewater effluent of secondary, Level III or Level IV quality. However, the ongoing 208 Programs are analyzing this situation.

- Based on modelling runs, decreases in BOD waste loads to the Jordan River from the South Davis South facility apparently have no direct effect on the dissolved oxygen concentration in the River.

SALT LAKE COUNTY

Salt Lake County as defined herein is comprised of all lands in Salt Lake County which directly drain to the Jordan River. This river system receives the majority of the waste loads directly or indirectly attributable to man's activity within the Study Area. Along the banks of the Jordan River are seven wastewater treatment plants and numerous industrial sources. In addition to these point source loadings, waste loads from non-point sources are also discharged to the River by way of irrigation return flows, canals, drains, and storm sewers.

Alternative wastewater treatment strategies considered for Salt Lake County are illustrated in Figure IV-7. For analysis of the water quality impacts, the alternatives are separated into two groups:

- all plants at Level III treatment (SLC-2, SLC-4, SLC-8, SLC-9, SLC-10, SLC-11, and SLC-12).
- all plants at Level IV treatment (SLC-1, SLC-3, SLC-5, SLC-6, and SLC-7).

The recommended plan is identical to the SLC-10 alternative.

Cost Analysis

Costs associated with alternative treatment strategies in Salt Lake County are presented in Table IV-3. The least expensive alternative in terms of annual per capita costs is SLC-10 or the recommended plan at $8.66/cap/year. These plans with secondary treatment have an associated cost of only 54 percent of the plans at Level III. The recommended alternative takes advantage of economies of scale by consolidating treatment at the Salt Lake City and Suburban Sanitation District No. 1 facilities. Further consolidation to one plant at Salt Lake City does not provide additional economies because of the long interceptors required. If only Level IV treatment was considered, SLC-6 would be the most economical at $15.58/cap/year.

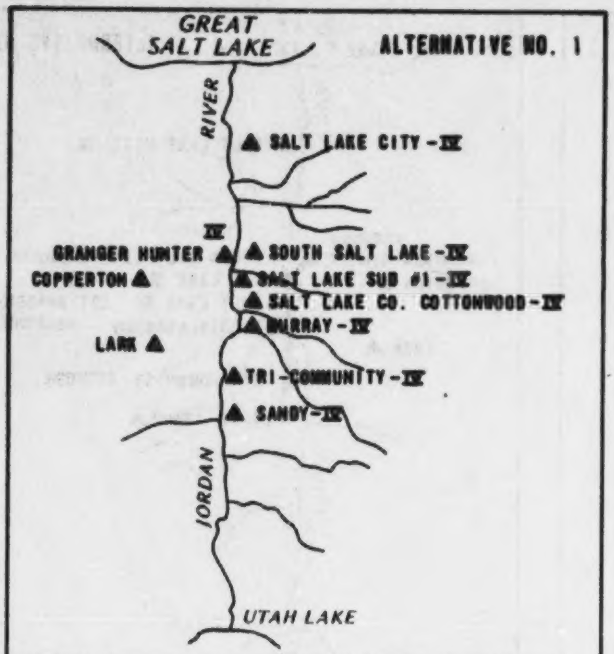
Waste Load Analysis

Waste loads for Salt Lake County were developed for point and non-point sources and are illustrated in Figures IV-8 to IV-12. Non-point sources are and will be significant sources of BOD, Total Dissolved Solids (TDS), Total Nitrogen (TN), and Total Suspended Solids (TSS) waste loadings, contributing from 25 percent to 99 percent of the total waste loading. Future non-point source loadings do not vary among alternatives because all alternatives are based on the same land use plan.

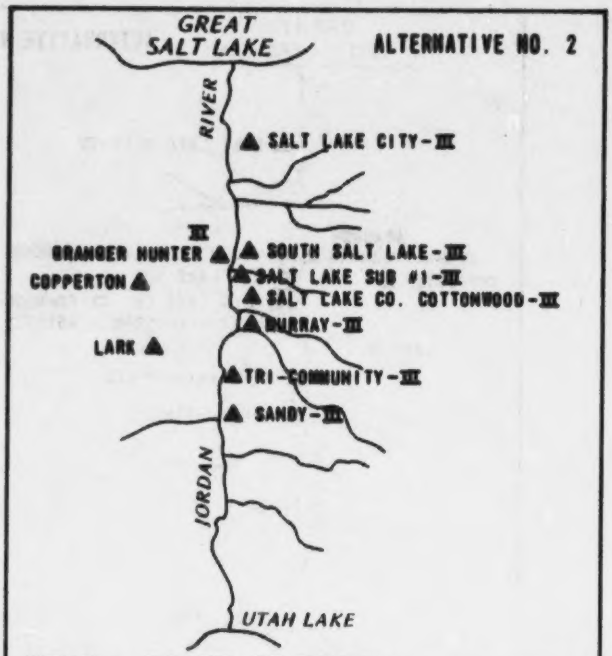
Considering point sources, only BOD and Phosphate (PO_4) point loadings vary among future alternatives. TDS and TN are unaffected by Level III and Level IV treatment processes and Total Suspended Solids contributions from point sources are minimal (less than one percent of total waste loadings).

FIGURE IV-7

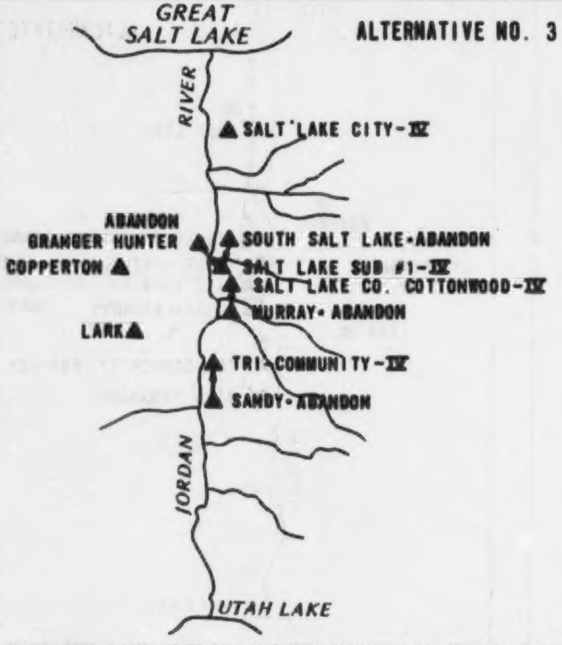
WASTEWATER TREATMENT ALTERNATIVES - SALT LAKE COUNTY


GREAT SALT LAKE
ALTERNATIVE NO. 1
RIVER
SALT LAKE CITY-IV
IV
GRANGER HUNTER
SOUTH SALT LAKE-IV
COPPERTON
SALT LAKE SUB #1-IV
SALT LAKE CO. COTTONWOOD-IV
MURRAY-IV
LARK
TRI-COMMUNITY-IV
SANDY-IV
JORDAN
UTAH LAKE

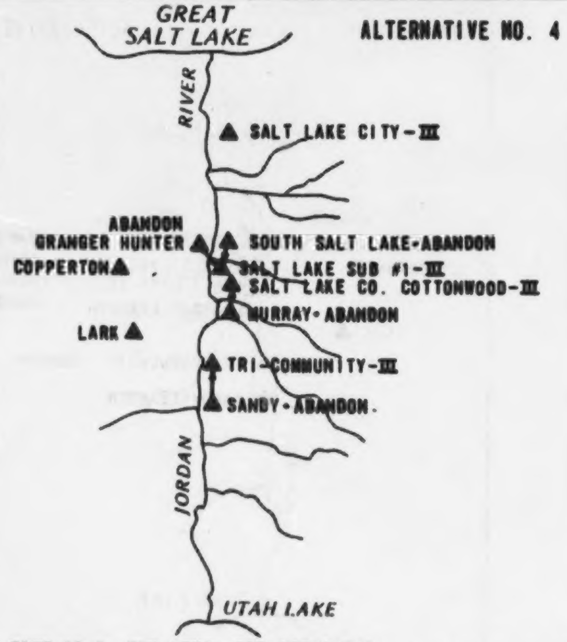
MODIFY AND EXPAND ALL EXISTING PLANTS AT EXISTING LOCATIONS.


GREAT SALT LAKE
ALTERNATIVE NO. 2
RIVER
SALT LAKE CITY-III
III
GRANGER HUNTER
SOUTH SALT LAKE-III
COPPERTON
SALT LAKE SUB #1-III
SALT LAKE CO. COTTONWOOD-III
MURRAY-III
LARK
TRI-COMMUNITY-III
SANDY-III
JORDAN
UTAH LAKE

SAME AS 1, BUT LEVEL III TREATMENT......................


GREAT SALT LAKE
ALTERNATIVE NO. 3
RIVER
SALT LAKE CITY-IV
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-IV
SALT LAKE CO. COTTONWOOD-IV
MURRAY-ABANDON
LARK
TRI-COMMUNITY-IV
SANDY-ABANDON
JORDAN
UTAH LAKE

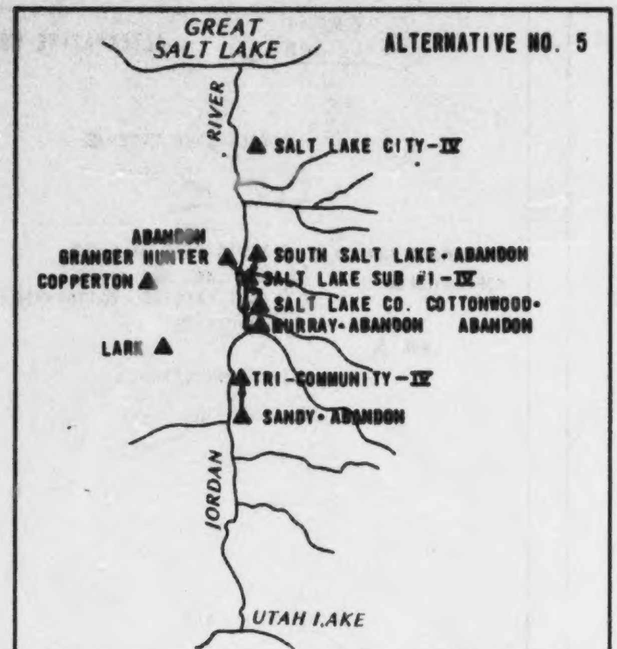
ABANDON SANDY, MURRAY, GRANGER-HUNTER AND SOUTH SALT LAKE PLANTS. CONVEY FLOWS FROM SANDY TO TRI-COMMUNITY, MURRAY TO COTTONWOOD AND FROM GRANGER-HUNTER AND SOUTH SALT LAKE TO SALT LAKE CITY SUBURBAN NO. 1. MODIFY AND EXPAND TRI-COMMUNITY, COTTONWOOD, SALT LAKE CITY SUBURBAN NO. 1 AND SALT LAKE CITY PLANTS. TREATMENT LEVEL IV.


GREAT SALT LAKE
ALTERNATIVE NO. 4
RIVER
SALT LAKE CITY-III
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-III
SALT LAKE CO. COTTONWOOD-III
MURRAY-ABANDON
LARK
TRI-COMMUNITY-III
SANDY-ABANDON.
JORDAN
UTAH LAKE

SAME AS 3, BUT LEVEL III TREATMENT......................

FIGURE IV-7 (Continued)

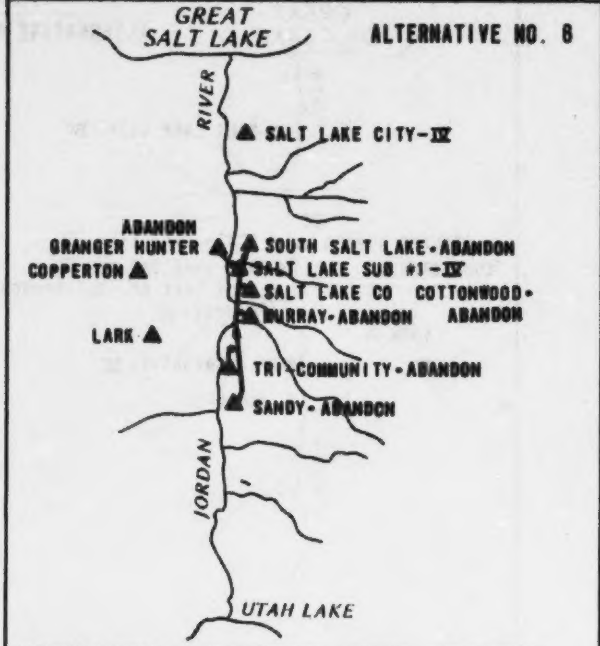
WASTEWATER TREATMENT ALTERNATIVES - SALT LAKE COUNTY



ALTERNATIVE NO. 5

GREAT SALT LAKE
RIVER
SALT LAKE CITY-IV
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-IV
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-IV
SANDY-ABANDON
JORDAN
UTAH LAKE

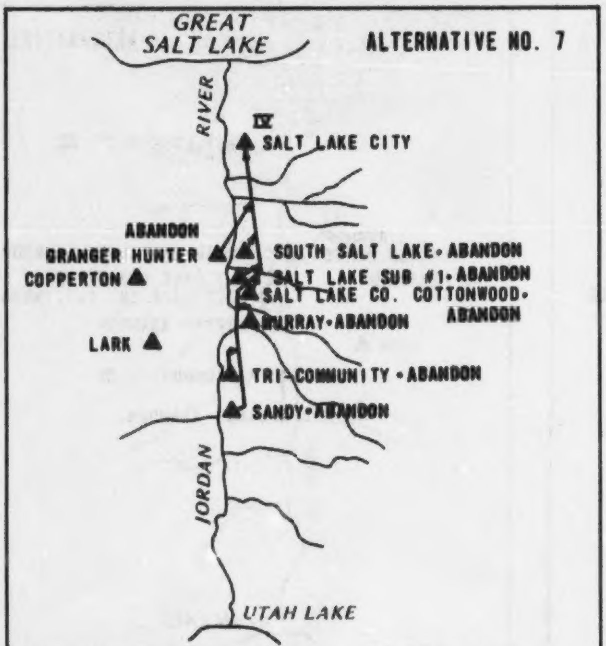
ABANDON SANDY, MURRAY, COTTONWOOD, GRANGER-HUNTER AND SOUTH SALT LAKE PLANTS. CONVEY FLOWS FROM SANDY TO TRI-COMMUNITY AND FROM MURRAY, COTTONWOOD, GRANGER-HUNTER AND SOUTH SALT LAKE TO SALT LAKE CITY SUBURBAN NO. 1 MODIFY AND EXPAND TRI COMMUNITY, SALT LAKE COUNTY SUBURBAN NO. 1 AND SALT LAKE CITY PLANTS. TREATMENT LEVEL IV.



ALTERNATIVE NO. 6

GREAT SALT LAKE
RIVER
SALT LAKE CITY-IV
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-IV
SALT LAKE CO COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-ABANDON
SANDY-ABANDON
JORDAN
UTAH LAKE

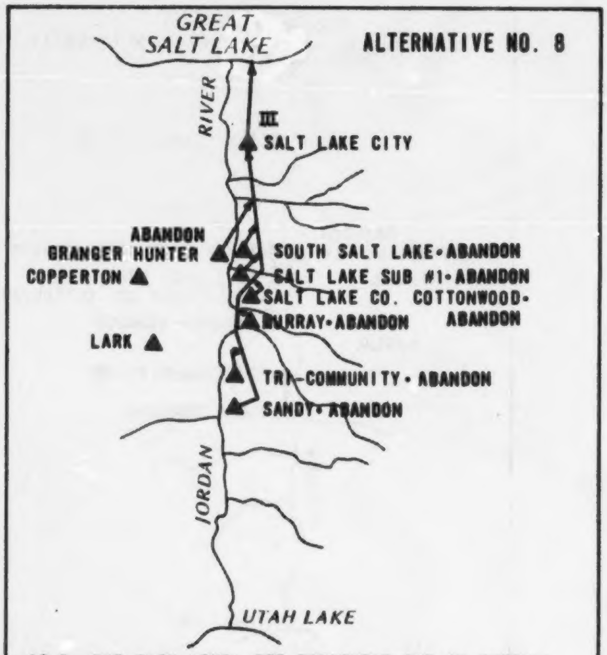
ABANDON SANDY, TRI-COMMUNITY, MURRAY, COTTONWOOD, GRANGER-HUNTER AND SOUTH SALT LAKE, AND CONVEY FLOWS TO SALT LAKE COUNTY SUBURBAN NO. 1. EXPAND AND MODIFY SALT LAKE COUNTY SUBURBAN NO. 1 AND SALT LAKE CITY PLANTS. TREATMENT LEVEL IV.



ALTERNATIVE NO. 7

GREAT SALT LAKE
RIVER
IV
SALT LAKE CITY
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-ABANDON
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-ABANDON
SANDY-ABANDON
JORDAN
UTAH LAKE

ABANDON ALL PLANTS EXCEPT SALT LAKE CITY PLANT. CONVEY ALL FLOWS TO MODIFIED AND EXPANDED SALT LAKE CITY PLANT. TREATMENT LEVEL IV.



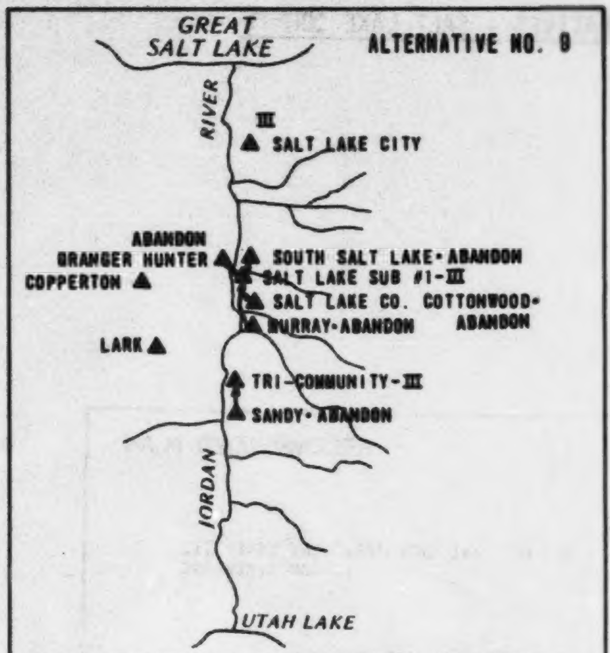
ALTERNATIVE NO. 8

GREAT SALT LAKE
RIVER
III
SALT LAKE CITY
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-ABANDON
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-ABANDON
SANDY-ABANDON
JORDAN
UTAH LAKE

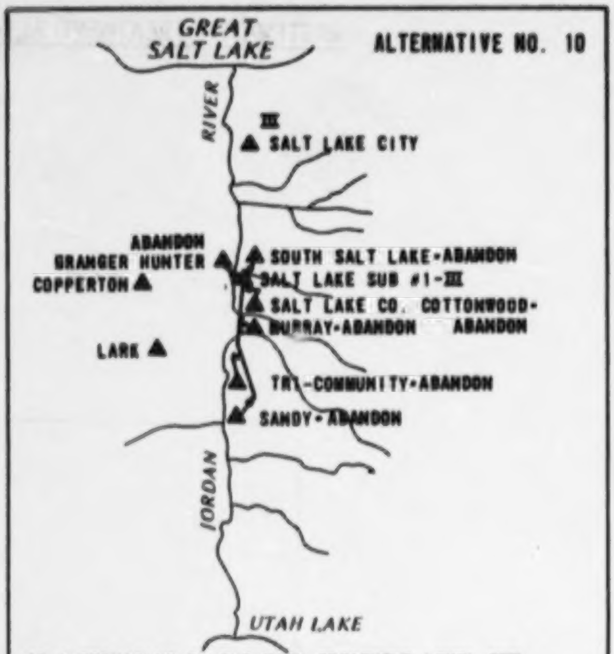
AS 7, BUT WITH LEVEL III TREATMENT AND AN OUTFALL TO GREAT SALT LAKE.

FIGURE IV-7 (Continued)

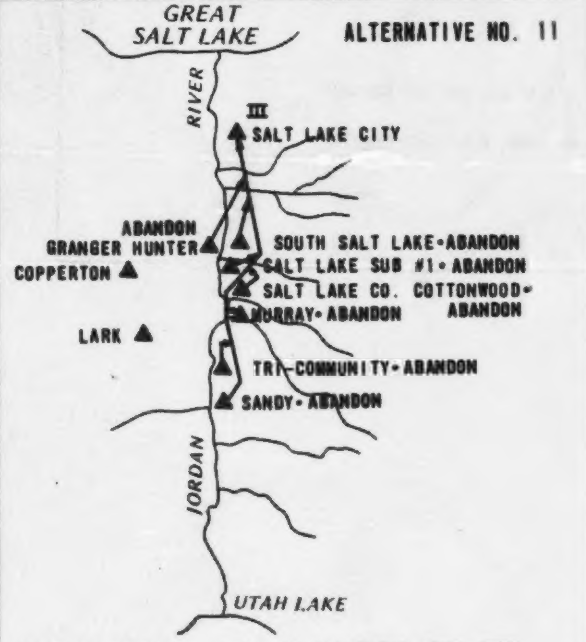
WASTEWATER TREATMENT ALTERNATIVES - SALT LAKE COUNTY


GREAT SALT LAKE
ALTERNATIVE NO. 8
RIVER
III
SALT LAKE CITY
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-III
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-III
SANDY-ABANDON
JORDAN
UTAH LAKE

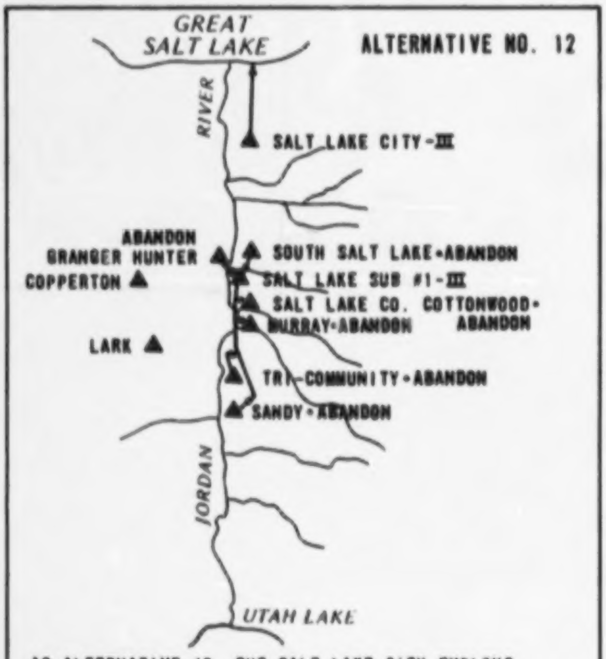
AS ALTERNATIVE 5, BUT WITH TREATMENT LEVEL III........


GREAT SALT LAKE
ALTERNATIVE NO. 10
RIVER
III
SALT LAKE CITY
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-III
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-ABANDON
SANDY-ABANDON
JORDAN
UTAH LAKE

AS ALTERNATIVE 6, BUT WITH TREATMENT LEVEL III........


GREAT SALT LAKE
ALTERNATIVE NO. 11
RIVER
III
SALT LAKE CITY
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-ABANDON
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-ABANDON
SANDY-ABANDON
JORDAN
UTAH LAKE

AS ALTERNATIVE 7, BUT WITH TREATMENT LEVEL III........


GREAT SALT LAKE
ALTERNATIVE NO. 12
RIVER
SALT LAKE CITY-III
ABANDON
GRANGER HUNTER
SOUTH SALT LAKE-ABANDON
COPPERTON
SALT LAKE SUB #1-III
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
LARK
TRI-COMMUNITY-ABANDON
SANDY-ABANDON
JORDAN
UTAH LAKE

AS ALTERNATIVE 10, BUT SALT LAKE CITY EMPLOYS LEVEL III TREATMENT WITH AN OUTFALL TO THE GREAT SALT LAKE.

FIGURE IV-7 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - SALT LAKE COUNTY

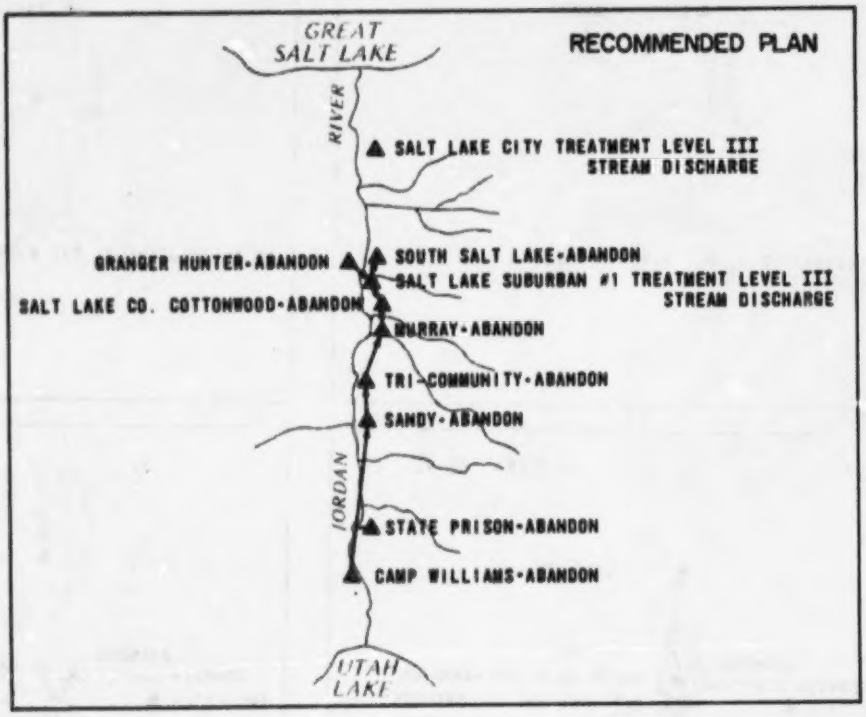

RECOMMENDED PLAN
GREAT SALT LAKE
RIVER
SALT LAKE CITY TREATMENT LEVEL III STREAM DISCHARGE
GRANGER HUNTER-ABANDON
SOUTH SALT LAKE-ABANDON
SALT LAKE SUBURBAN #1 TREATMENT LEVEL III STREAM DISCHARGE
SALT LAKE CO. COTTONWOOD-ABANDON
MURRAY-ABANDON
TRI-COMMUNITY-ABANDON
SANDY-ABANDON
JORDAN
STATE PRISON-ABANDON
CAMP WILLIAMS-ABANDON
UTAH LAKE

TABLE IV-3

COST ANALYSIS FOR SALT LAKE COUNTY

Categories of Alternatives	Capital Cost ($$10^6$)	Annual Operation & Maintenance Cost ($$10^6$/Yr)	Annual Cost Per Capita ($/Cap/Yr)
Level III Alternatives			
SLC-2	40.39	3.06	10.99
SLC-4	37.31	2.49	9.52
SLC-8	73.37	1.90	12.58
SLC-9	36.54	2.27	8.98
SLC-10	36.99	2.10	8.66
SLC-11	53.07	1.76	10.05
SLC-12	47.92	2.18	10.03
Level IV Alternatives			
SLC-1	79.60	4.82	19.74
SLC-3	70.66	4.23	17.36
SLC-5	67.04	4.02	16.40
SLC-6	64.59	3.83	15.58
SLC-7	76.07	3.46	16.24
Recommended Plan			
Level III	36.99	2.10	8.66
Secondary	21.79	1.07	4.70

FIGURE IV-8

BOD WASTE LOADS - SALT LAKE COUNTY

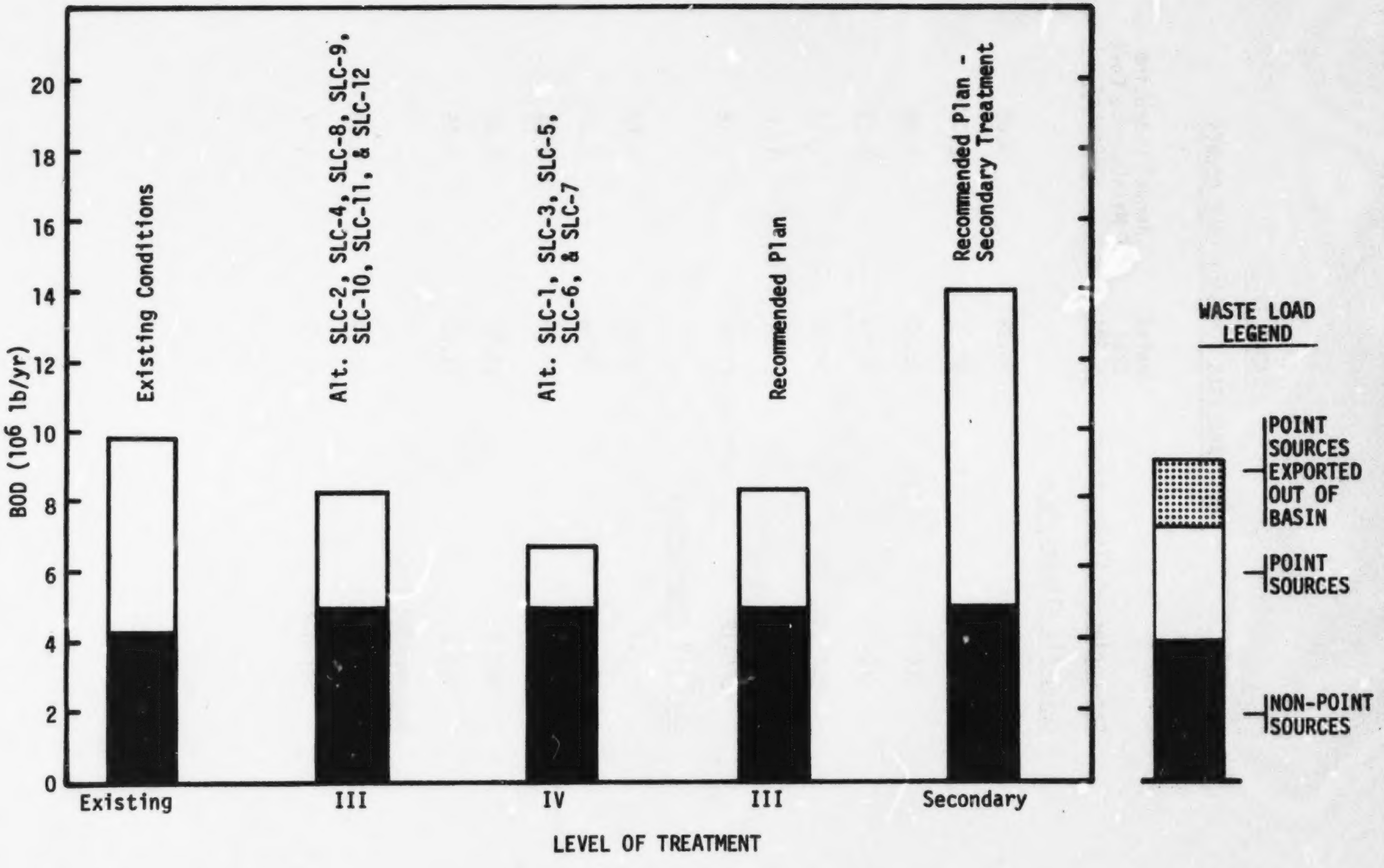


FIGURE IV-9

TDS WASTE LOADS - SALT LAKE COUNTY

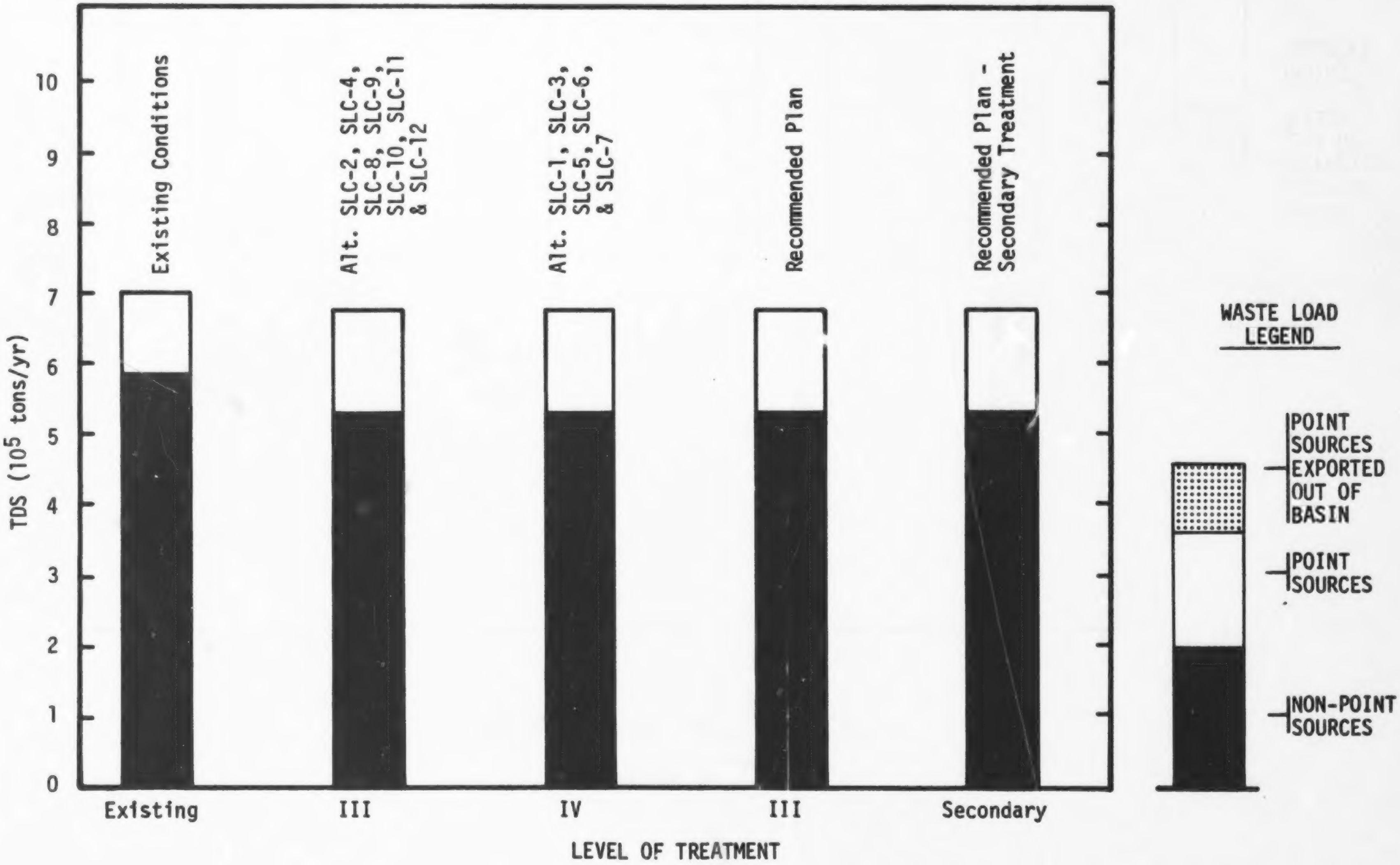


FIGURE IV-10

TN WASTE LOADS - SALT LAKE COUNTY

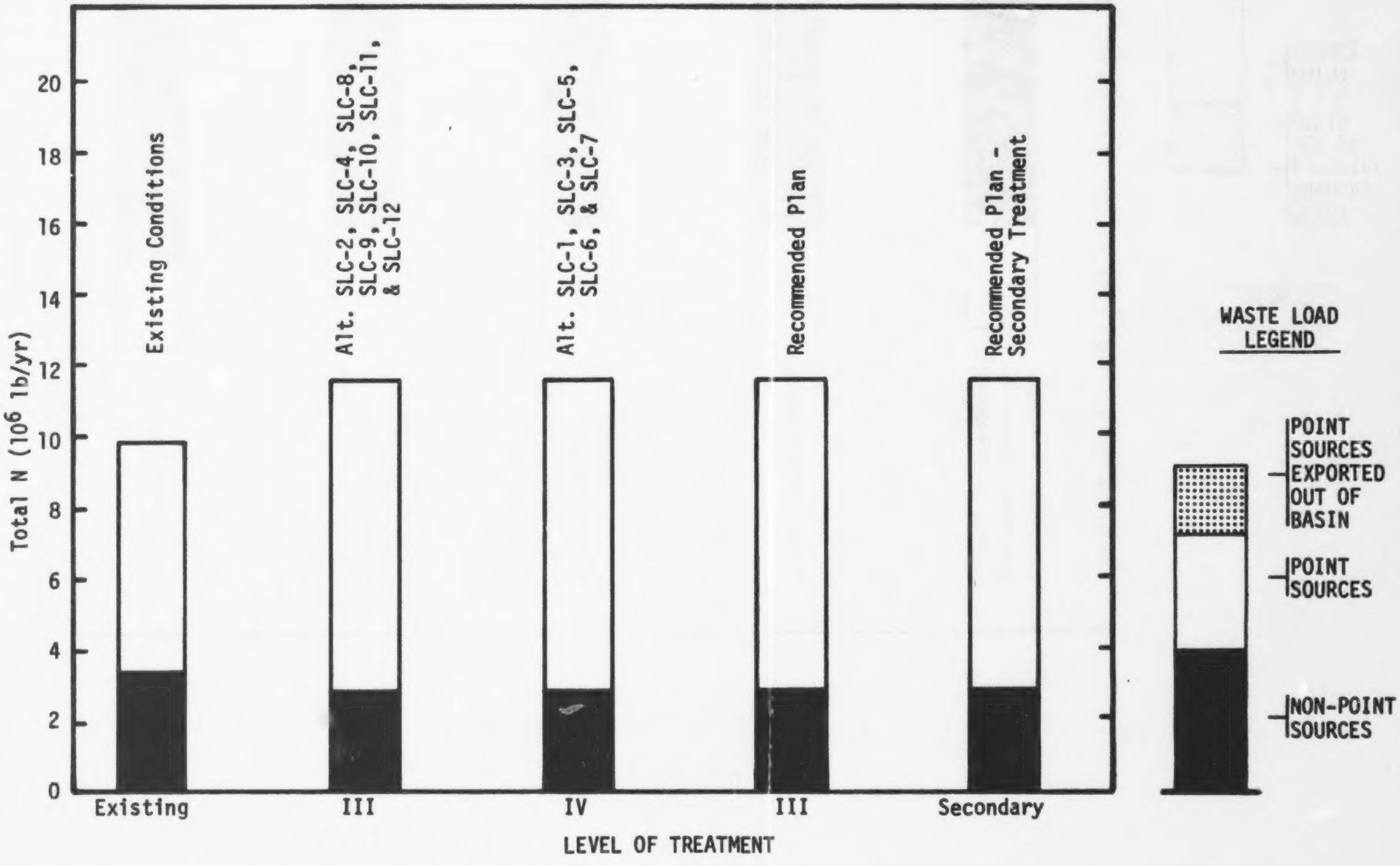


FIGURE IV-11

PO_4 WASTE LOADS - SALT LAKE COUNTY

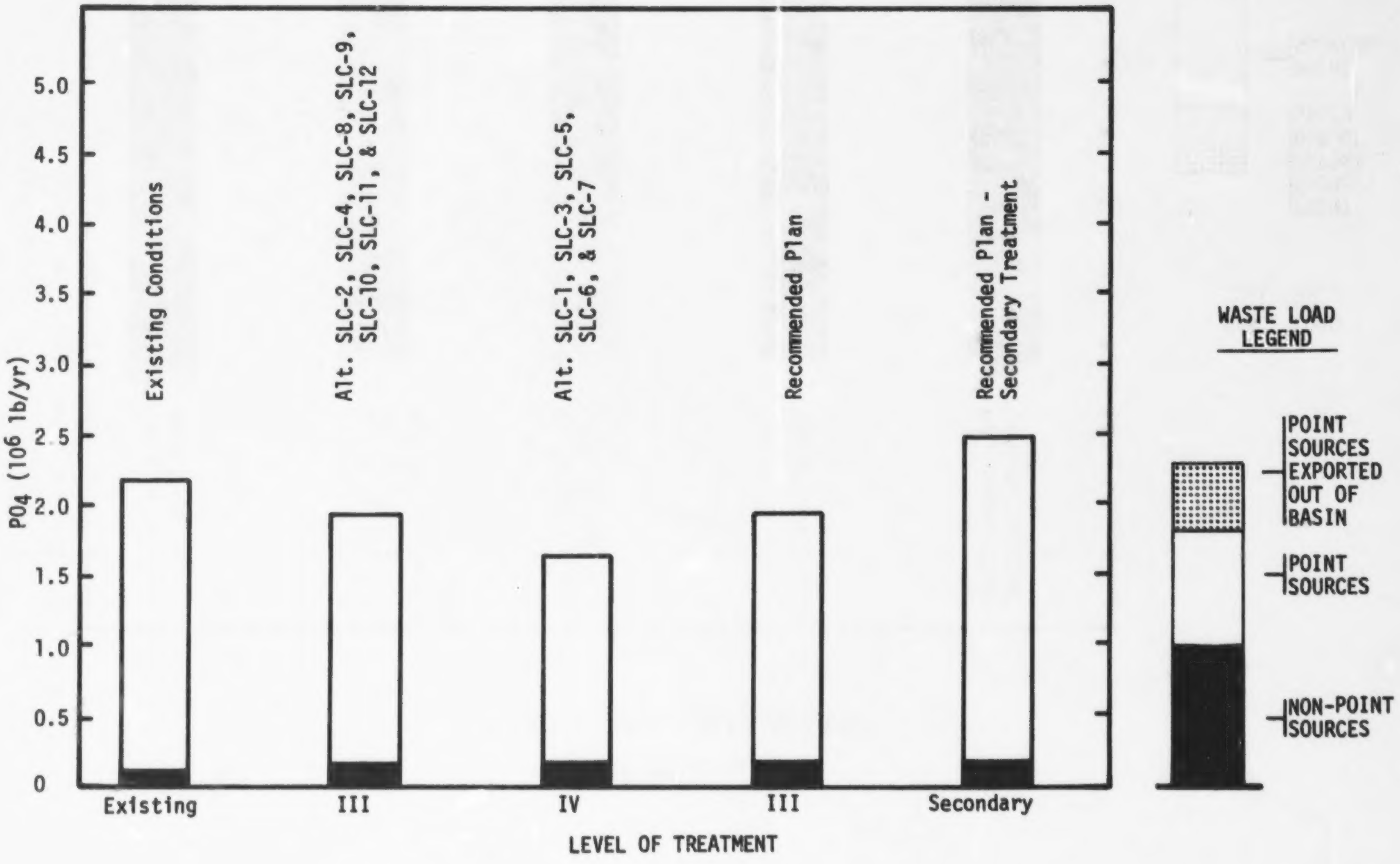
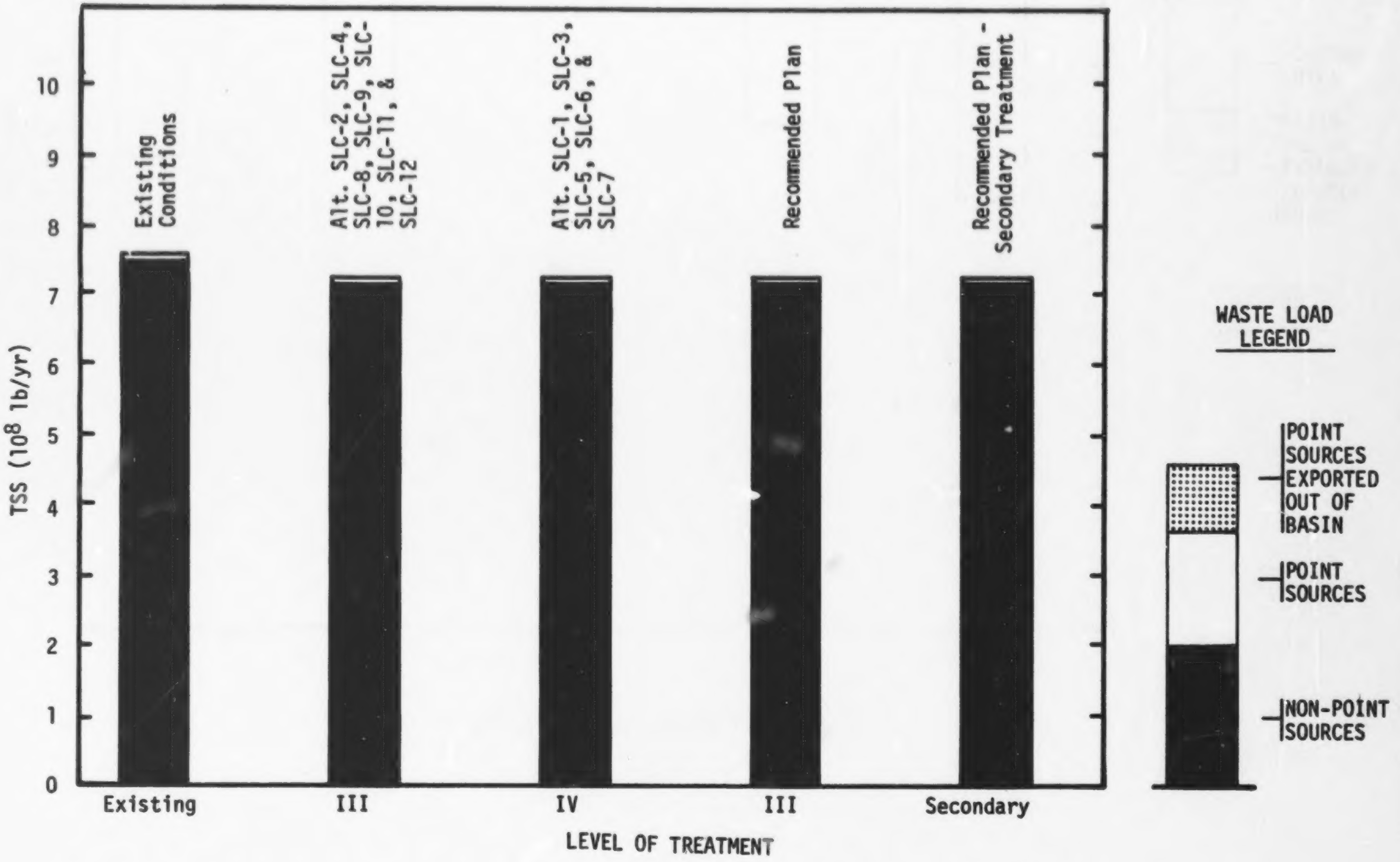


FIGURE IV-12

TSS WASTE LOADS - SALT LAKE COUNTY



Because wastewater treatment plant effluent is the major source of PO4 in Salt Lake County, the PO4 total waste load can be reduced by advanced treatment. Level III treatment produces some reduction in the existing waste load, but because wastewater flows are increased (by population increases) in proportion to PO4 reductions, the net effect is only 13 percent. Level IV treatment results in a somewhat larger reduction, approximately 25 percent. If the recommended plan was implemented at secondary treatment, a 16 percent increase would be realized over existing PO4 levels.

Total BOD waste loadings resulting from various alternatives manifest reductions similar to PO4 loads. Level III alternatives reduce existing point source loads and Level IV alternatives account for an even greater reduction. If secondary treatment was considered within the recommended plan, total BOD loadings would increase from 10 million pounds per year to 14 million pounds per year or 40 percent due to population increases.

Coliform bacteria loadings from point sources can be expected to decrease under all future alternatives because of the strict effluent limitations on coliform bacteria for all levels of treatment considered.

An analysis of the Dissolved Oxygen (DO) response in the Jordan River to the various treatment alternatives reveals that the State of Utah's Class "CC" Standard of 6.0 mg/l DO will be violated in the lower Jordan River under all alternatives. In fact, even with no point source BOD discharges to the Jordan River (SLC-7, SLC-8, and SLC-11), the State standard of 6.0 mg/l will still be violated because of non-point sources. Additionally, water quality, as measured by DO, in the Jordan River downstream of the Suburban Sanitation District No. 1 facility (north of 21st Street South) is independent of the alternatives at any single level of treatment, and only a 0.2-0.4 mg/l increase in DO can be expected in the Jordan River if Level IV treatment is implemented rather than Level III.

Aquatic Impact

Potential aquatic ecosystem impacts as a result of the implementation of wastewater treatment alternatives in Salt Lake County can be assessed in light of existing conditions in the Jordan River. Existing mean DO concentration in the River is below the Utah State Standard for Class "CC" waters (6.0 mg/l) and a minimum DO of 2.8 mg/l has been recorded. The phosphate criteria of 0.05 mg/l is exceeded throughout the Jordan River with a maximum observation of 9.0 mg/l. Additionally, bottom substrate conditions are poor throughout the river except for a few miles downstream of the Jordan Narrows and fish population from 7800 Street South to the Great Salt Lake consists entirely of rough fish, although fish population from the Jordan Narrows to 7800 Street South consists of predominantly warm water game fish.

It should be noted that BOD waste loads to an aquatic ecosystem can produce both detrimental impacts (DO reduction) or beneficial impacts (required nutrient for a productive system). Depressed concentrations of DO can be tolerated by various organisms for different lengths of time. This is dependent on other water quality conditions, time of day, and season of year. However, DO levels in the aquatic ecosystem must meet critical life process requirements of the organisms if those organisms are to sustain themselves. It is likely that decreasing DO concentrations below existing conditions in the Jordan River will begin to stress the ecosystem components and eliminate some less tolerant organisms. For example, under extreme conditions, warm water fish can be maintained at DO levels between 4 and 5 mg/l provided other water quality conditions are favorable. If a diversified warm water biota, including game fish, are desired, DO concentrations should be above 5 mg/l. This also assumes other parameters are within species tolerance levels, not only for fish but for fish food organisms.

BOD is characteristically viewed as an oxygen demand on the aquatic system. However, minimum concentrations of BOD are necessary to provide a "nutrient" loading for utilization in the aquatic ecosystem. No minimum BOD requirements have been established in terms of survival needs of the ecosystem, but apparently in the Jordan River a lack of BOD is not a problem.

These waste load/ecosystem interrelationships and the modelling efforts and projected waste loadings illustrated in Figures IV-8 to IV-12 lead to the following conclusions:

1. Alternatives utilizing Level III treatment are not likely to significantly change the aquatic habitat of the Jordan River.
2. Level IV treatment may show some aquatic habitat improvement but even this is questionable.
3. Alternatives which consolidate treatment of all wastewater at the Salt Lake City Plant with eventual discharge to Great Salt Lake produce the highest DO concentrations in the Jordan River, but still under 6.0 mg/l.
4. Increases in nitrogen as a nutrient load to the Jordan River for alternatives with River discharges will increase the density of vegetation, other factors being favorable. This increase, which may in itself be a nuisance, can cause an additional BOD loading after death of the aquatic plants, may inhibit recreational use of the River, clog irrigation gates and equipment, cause overpopulation and stunting of fish species, and reduce desirable species of benthic organisms by producing anaerobic bottom conditions.
5. Discharges to Great Salt Lake of secondary, Level III or Level IV treated wastewater have an unknown impact on the Lake because of the diking of Farmington Bay. For the Salt Lake County Area, this would apply to discharges from the Salt Lake City facility to the Great Salt Lake via the sewage canal.
6. Decreases in PO_4 due to advanced treatment Level III or Level IV may have no significant impact on the aquatic ecosystem because nitrogen has been defined as the limiting nutrient.

Summary

Based on the previous discussion regarding costs, waste loads, and aquatic impacts of alternative wastewater treatment schemes in Salt Lake County, the following observations can be made:

- At Level III treatment, Alternatives SLC-9 and SLC-10 are the most economical.
- At Level IV treatment, SLC-6 is the cheapest.
- The recommended plan with secondary treatment has a cost of only 54 percent of the recommended plan at Level III.
- Non-point sources are significant sources of BOD, TDS, TN, and TSS waste loads.
- The results of modelling efforts indicate that DO concentrations in the Jordan River will drop below the Utah State Standard of 6.0 mg/l for all levels of treatment because of BOD loadings by non-point sources.
- No significant DO increase in the Jordan River will be observed if Level IV treatment is implemented rather than Level III.
- DO concentrations downstream of SLC - SSD #1 (north of 21st Street South) are independent of the degree of regionalization, assuming the same level of treatment at all plants.
- The existing water quality and bottom substrate conditions are poor for a viable aquatic habitat in the Jordan River. Implementation of Level III or Level IV alternatives is not likely to improve these conditions. Conveying all wastewater to the Salt Lake City facility with discharge to Great Salt Lake via the Sewage Canal improves the water quality to some degree, but still not enough to support a cold water fishery.
- Reducing PO_4 waste loads will likely have no aquatic impact because the Jordan River is nitrogen deficient. Because of the situation, however, future increases in TN waste loads may cause nuisance aquatic growth and secondary impacts.

MAGNA AREA

The Magna Area comprises that portion of Salt Lake County which drains directly into Great Salt Lake. One community, Magna, the single largest industrial complex in the Study Area, Kennecott Copper, a chemical plant, and several salt and mineral recovery operations are essentially the totality of man's development in the Magna Area. Because of this limited urban development, no detailed discussion is presented in the Plan on alternative wastewater treatment schemes for the area. A recommendation is made that Magna implement Level III treatment. An attempt was made to broaden the analysis by comparing the benefits of the recommended plan (Level III treatment) to Level IV and to secondary treatment. These alternatives are shown in Figure IV-13.

Cost Analysis

The treatment costs associated with each of the Magna Area alternatives are presented in Table IV-4. The recommended plan with Magna at Level III is obviously more economical than the Level IV treatment alternative. However, the cost of the recommended plan with secondary treatment has an associated cost of only 55 percent of the recommended plan at Level III.

FIGURE IV-13

WASTEWATER TREATMENT ALTERNATIVES
MAGNA AREA

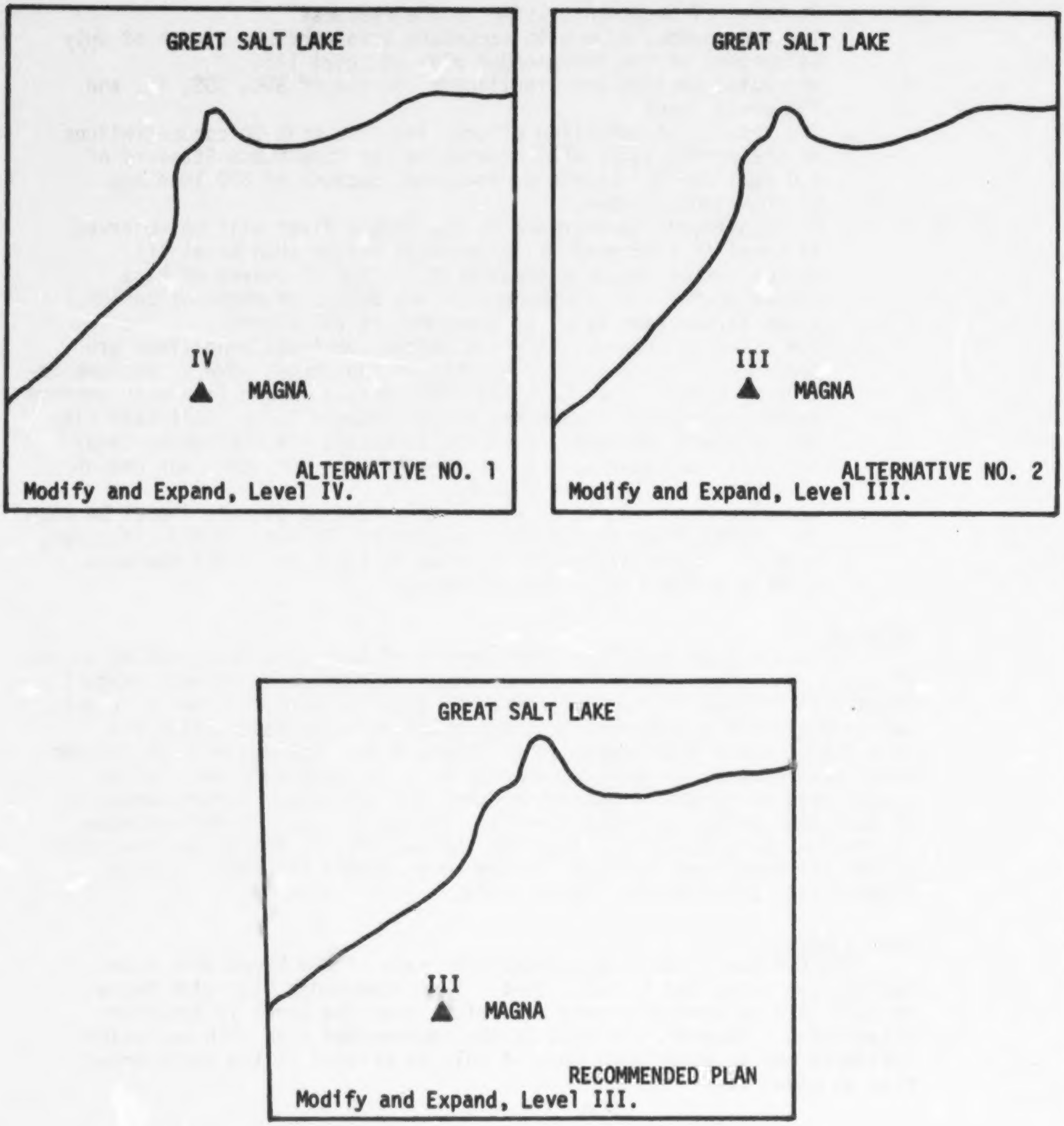

GREAT SALT LAKE
IV
MAGNA
ALTERNATIVE NO. 1
Modify and Expand, Level IV.
GREAT SALT LAKE
III
MAGNA
ALTERNATIVE NO. 2
Modify and Expand, Level III.
GREAT SALT LAKE
III
MAGNA
RECOMMENDED PLAN
Modify and Expand, Level III.

TABLE IV-4

COST ANALYSIS FOR MAGNA AREA

Categories of Alternatives	Capital Cost ($$10^6$)	Annual Operation & Maintenance Cost ($$10^6$/Yr)	Annual Cost Per Capita ($/Cap/Yr)
Level III Alternative			
MA-2	1.73	0.15	24.22
Level IV Alternative			
MA-1	3.13	0.19	38.28
Recommended Plan			
Level III	1.73	0.15	24.22
Secondary	0.93	0.08	13.28

Waste Load Analysis

Point and non-point waste loads for the Magna Area are illustrated in Figures IV-14 through IV-18. Because of the minimal development anticipated for the area, future non-point loads are not expected to change significantly from existing conditions. Future point source pollutant loads for all parameters considered except Total Suspended Solids are expected to decrease markedly under any alternative treatment scheme. This would include coliform bacteria. The fact that any alternative manifests almost the identical reduction reflects the significant contribution from industry to the area's point source loading. Future industrial wastewater effluents were assumed to meet EPA effluent requirements and because these sources comprise such a large part of total point source loadings to the area, the various levels of proposed treatment at Magna have little effect on the total point source waste load.

Aquatic Impact

It is difficult to derive any quantitative aquatic impacts associated with the alternative wastewater treatment schemes for the Magna area because of the heavy industrial contribution and the lack of existing water quality data. Notwithstanding this situation, it seems reasonable to conclude that advanced wastewater treatment alternatives are not likely to alter future aquatic impacts because of the extremely large contributions of industrial waste loads. Localized aquatic impacts to Kersey Creek may be improved with advanced treatment, but because this Creek is more of a drainage canal for surrounding tailing ponds than a viable stream, it is questionable if advanced treatment would significantly improve the aquatic ecosystem. If the predicted reductions in industrial waste loads are realized, some aquatic habitat improvement may result in the drains and canals serving the Magna Area. However, because of the natural character of these waters, such improvement is questionable.

Summary

The following observations are made regarding the costs, waste loads, and aquatic impacts associated with the Magna Area wastewater treatment alternatives:

- The recommended plan with Level III treatment for Magna is nearly twice as expensive as secondary treatment and two-thirds the cost of Level IV treatment.
- Industrial sources contribute 90-95 percent of the total point source waste loads of BOD, TDS, PO_4, and TSS, and 35 percent of the TN waste load. Future reductions in future waste loads are primarily attributable to industrial waste load reductions not advanced wastewater treatment.
- Advanced wastewater treatment processes are not likely to alter any future water quality impacts even at the localized level.

NORTHERN UTAH COUNTY

Northern Utah County comprises the area drained by the American Fork River. The major communities in the area are Lehi, American Fork,

FIGURE IV-14

BOD WASTE LOADS - MAGNA AREA

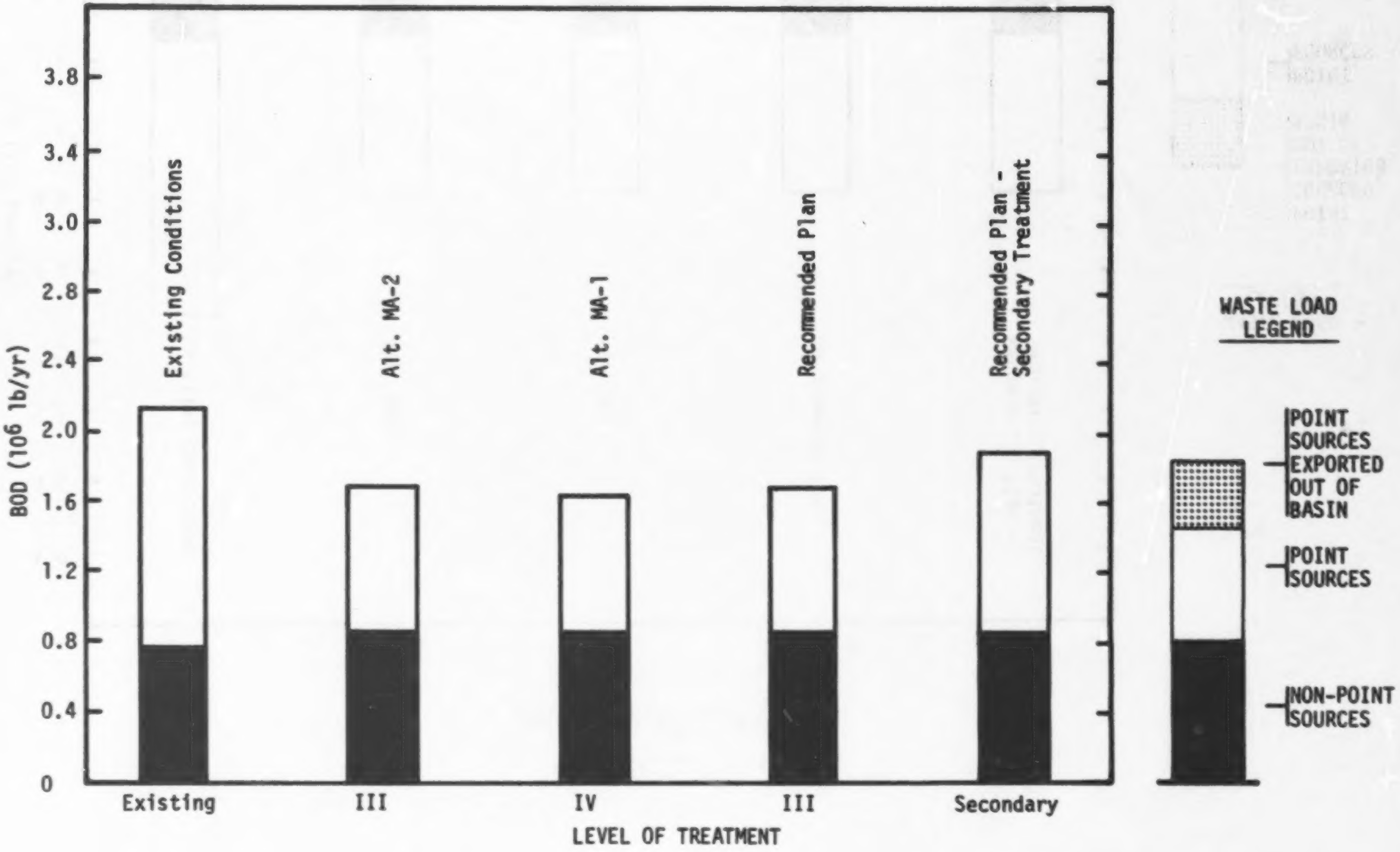


FIGURE IV-15

TDS WASTE LOADS - MAGNA AREA

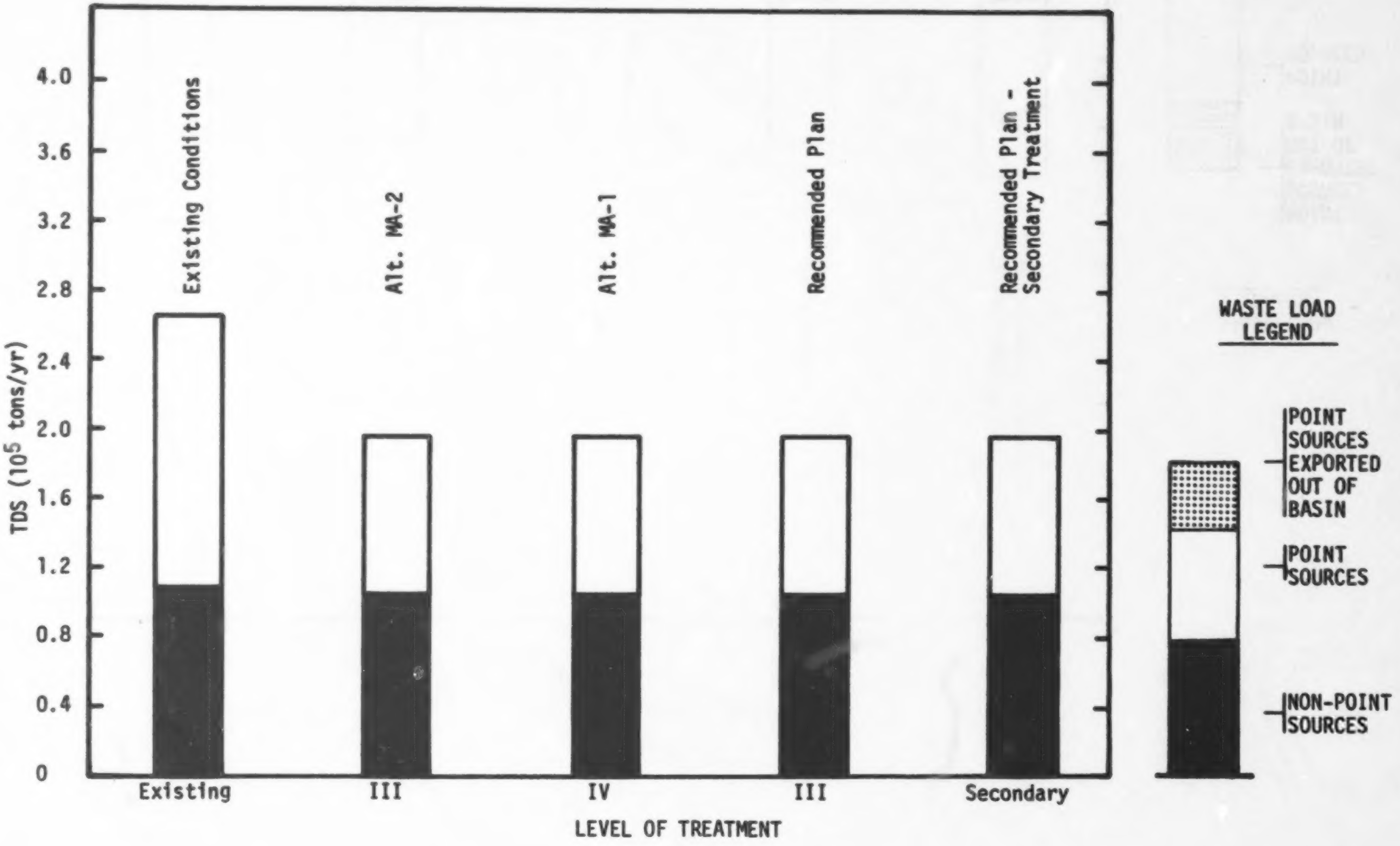


FIGURE IV-16

TN WASTE LOADS - MAGNA AREA

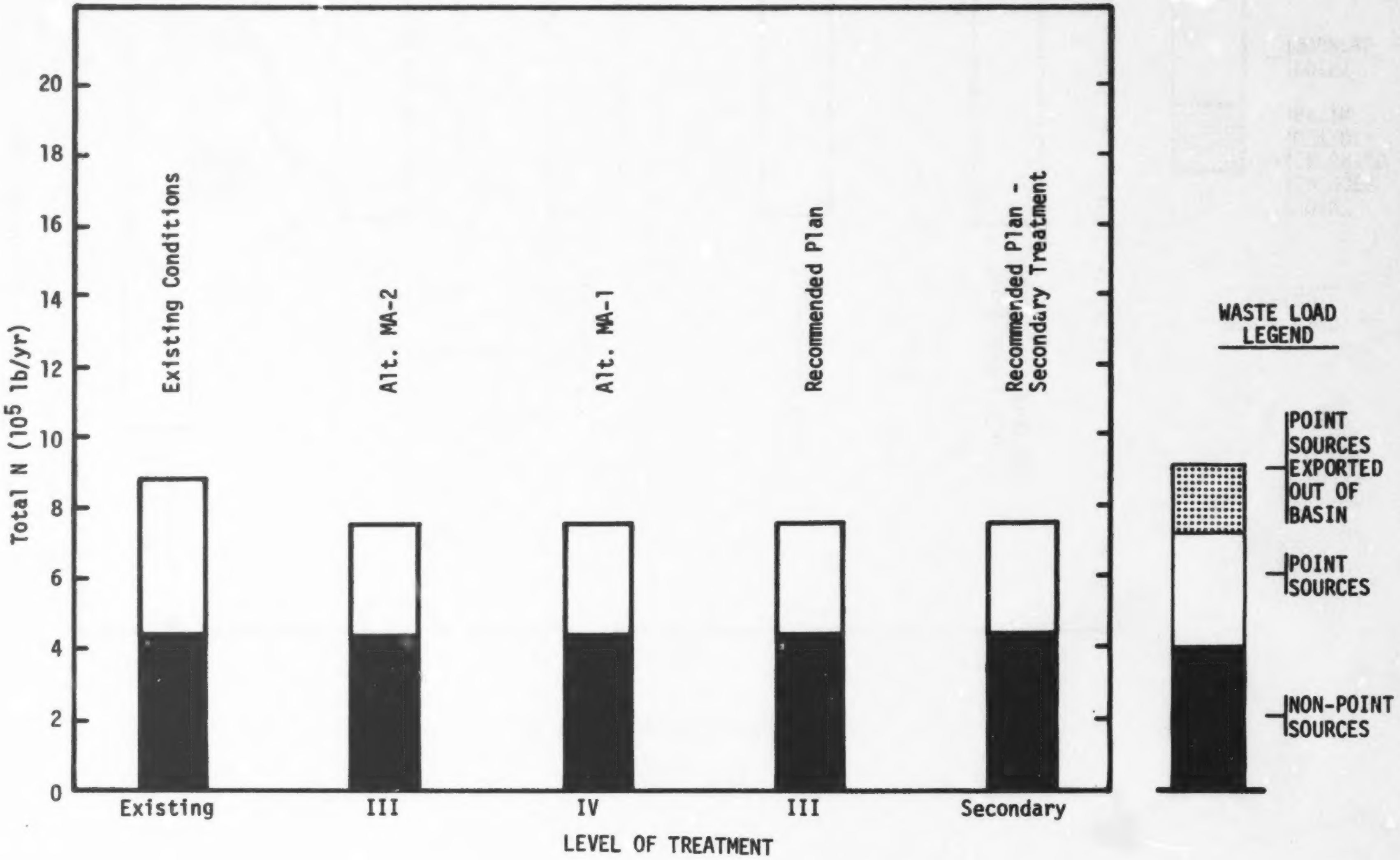


FIGURE IV-17

PO_4 WASTE LOADS - MAGNA AREA

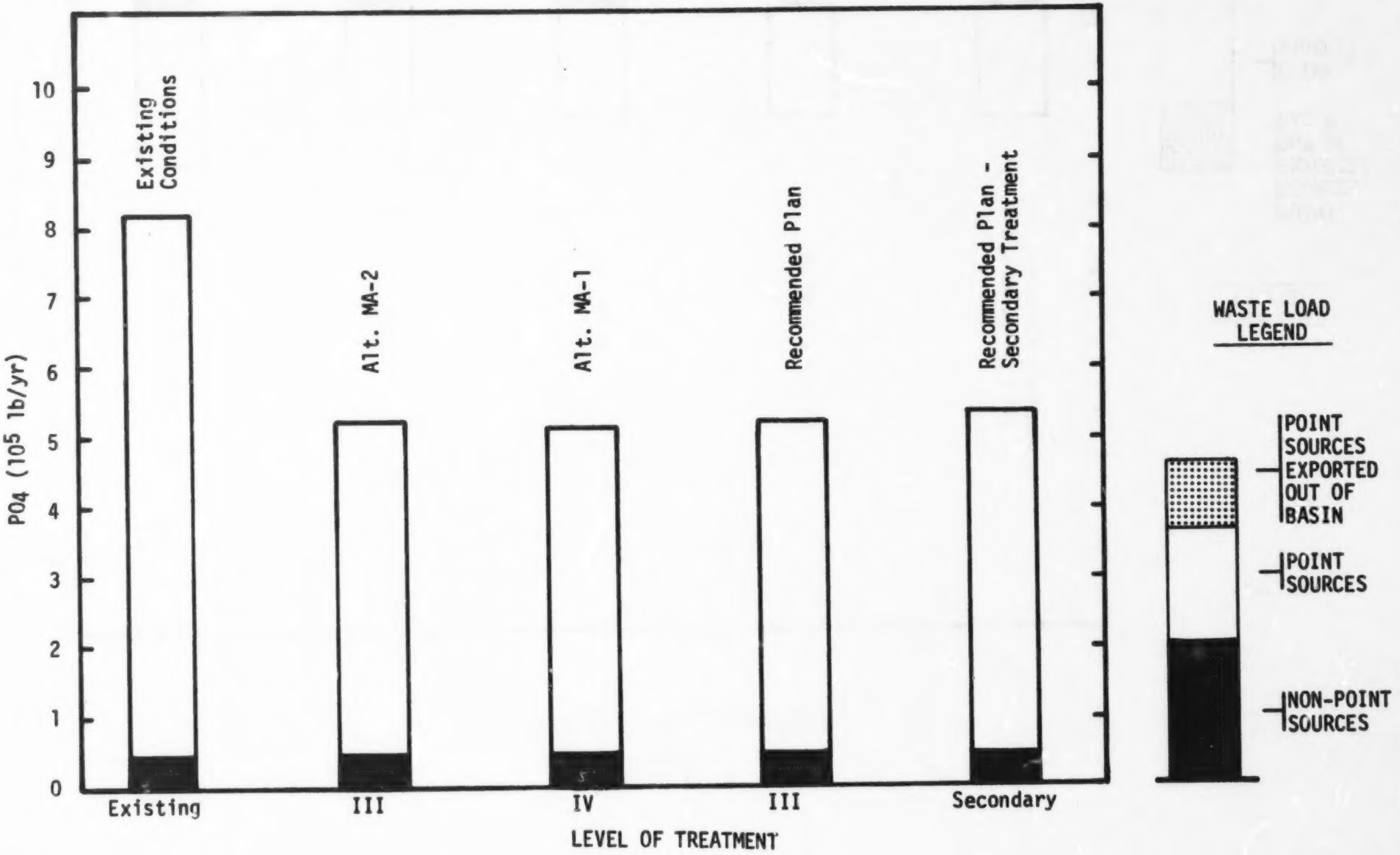
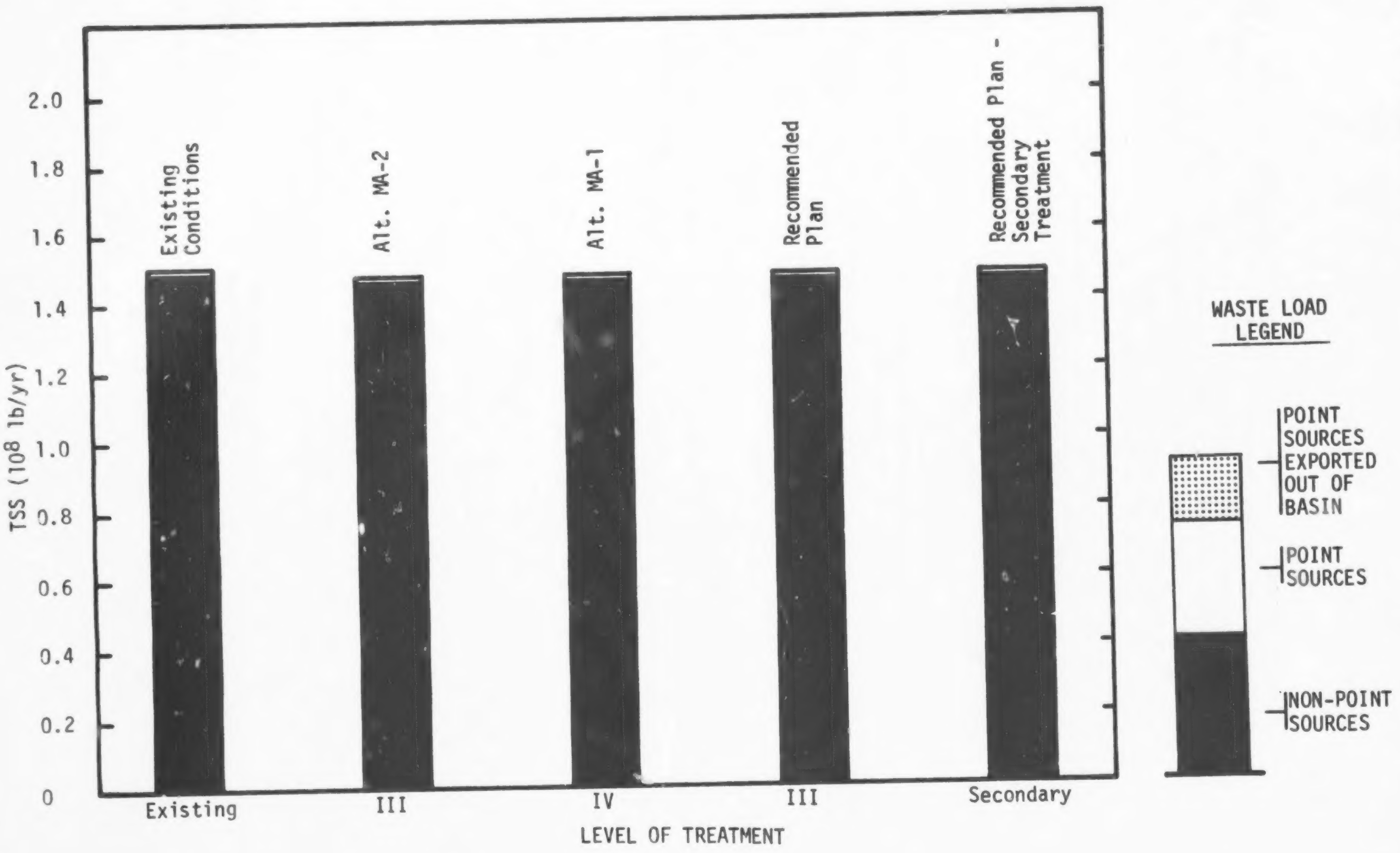


FIGURE IV-18

TSS WASTE LOADS - MAGNA AREA



Pleasant Grove, and Orem. The treatment alternatives considered in the Plan include various degrees of regionalization for these communities including several which convey all of the wastewater to a new plant near Provo. These alternatives are illustrated in Figure IV-19. For purposes of analysis, these alternatives are separated into three distinct groups:

- all plants at Level III treatment
- all plants at Level IV treatment
- a combination of Level III and Level IV treatment plants.

Strict Level III alternatives include NUC-2, NUC-3, NUC-6, NUC-7, and NUC-8. Level IV treatment alternatives are NUC-1, NUC-5, and NUC-9. Alternative NUC-4 is comprised of Level IV treatment at Lehi, Pleasant Grove, and Orem and Level III at American Fork. Alternatives NUC-10, NUC-11, and NUC-12 were not evaluated because of the local commitments being made in Provo (see Chapter III).

Cost Analysis

Associated costs of Northern Utah County wastewater treatment alternatives are presented in Table IV-5. The most economical plan alternative is NUC-2 at $17.04/cap/year. The recommended plan is one of the least costly, $18.02/cap/year and could be implemented for $9.92/cap/year if secondary treatment was permitted. If Level IV treatment is desired, NUC-9 at $26.92/cap/year would be less costly than any other alternative in the group.

Waste Load Analysis

Point and non-point waste loads for Northern Utah County are illustrated in Figures IV-20 to IV-24. Nitrate (NO_3) values are presented in Figure IV-22 instead of Total Nitrogen because NO_3 data is much more prevalent for the area.

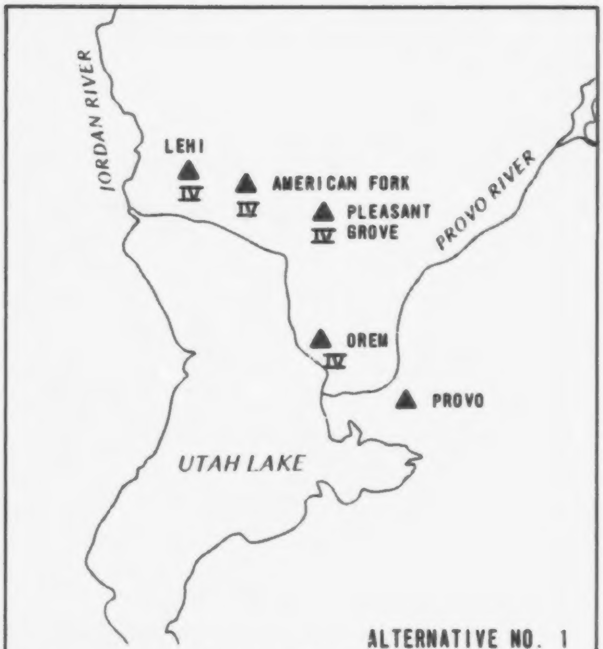
Non-point sources account for a significant portion of BOD, Total Suspended Solids (TSS), and Total Dissolved Solids (TDS) waste loads. Future BOD and TSS non-point source loadings do not vary significantly from existing conditions, but future TDS non-point source loadings do decrease approximately 25 percent. NO_3 and Phosphates (PO4) contributions from non-point sources are less than seven percent and 20 percent, respectively, of existing or any alternative future condition.

Of the parameters considered, TDS is unaffected by treatment levels, thus all future alternatives manifest identical total waste loadings. TSS, although affected by treatment level, does not reflect different loadings among alternatives because the point source contribution represents less than one percent of the total waste loading. Effluent nitrate concentrations are not affected by going from Level III to Level IV treatment, thus no variation in nitrates is manifested among alternatives.

BOD and PO_4 are a function of treatment level, however with Level III treatment, the total future BOD waste load is essentially the same, 1.7 million pounds per year, as the present, because BOD reductions are offset by population growth. If Level IV treatment is implemented, the BOD waste load would decrease to about 1.5 million pounds per year.

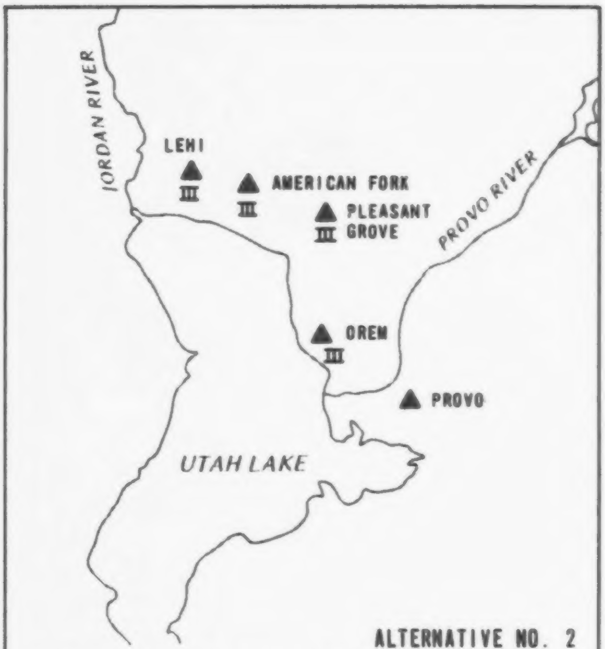
FIGURE IV-19

WASTEWATER TREATMENT ALTERNATIVES - NORTHERN UTAH COUNTY


JORDAN RIVER
LEHI
IV
AMERICAN FORK
IV
PLEASANT GROVE
IV
PROVO RIVER
OREM
IV
PROVO
UTAH LAKE

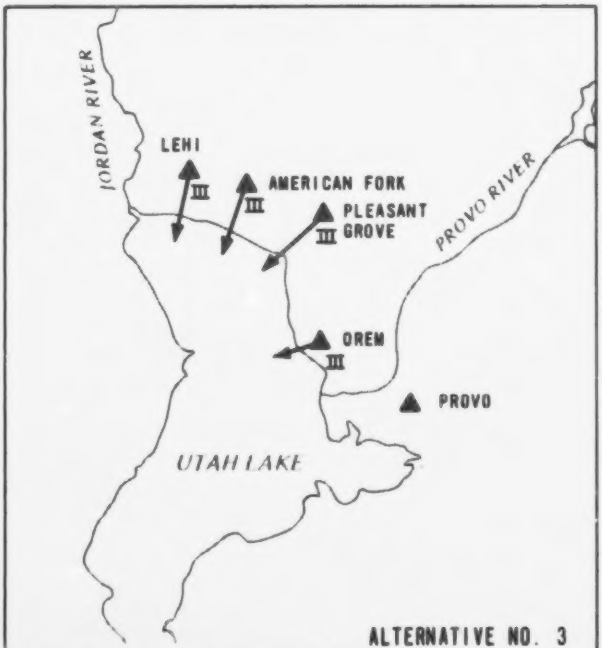
ALTERNATIVE NO. 1

MODIFY AND EXPAND EXISTING PLANTS AT EXISTING LOCATIONS. LEVEL IV TREATMENT AT ALL PLANTS


JORDAN RIVER
LEHI
III
AMERICAN FORK
III
PLEASANT GROVE
III
PROVO RIVER
OREM
III
PROVO
UTAH LAKE

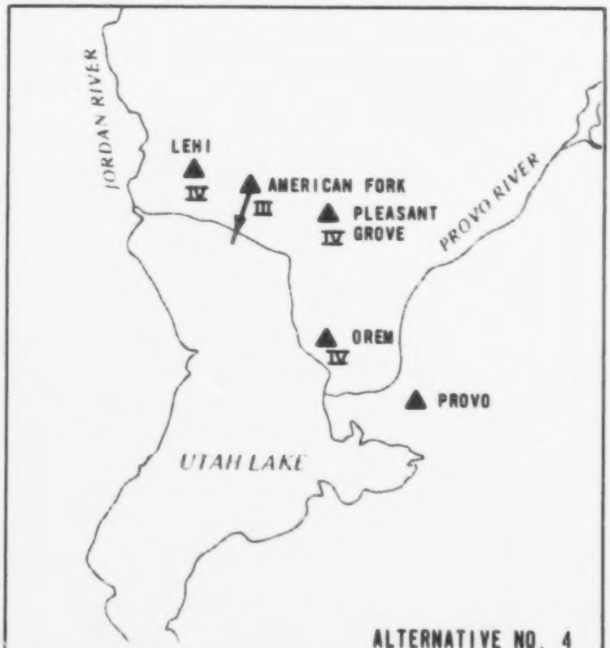
ALTERNATIVE NO. 2

SAME AS ALTERNATIVE 1, BUT TREATMENT LEVEL III........


JORDAN RIVER
LEHI
III
AMERICAN FORK
III
PLEASANT GROVE
III
PROVO RIVER
OREM
III
PROVO
UTAH LAKE

ALTERNATIVE NO. 3

MODIFY AND EXPAND EXISTING PLANTS AT EXISTING LOCATIONS. LEVEL III TREATMENT AND LAKE OUTFALLS AT EACH POINT.

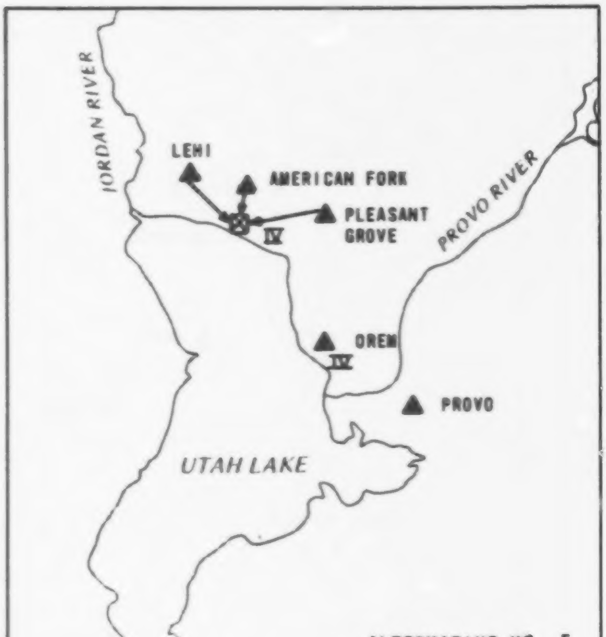

JORDAN RIVER
LEHI
IV
AMERICAN FORK
III
PLEASANT GROVE
IV
PROVO RIVER
OREM
IV
PROVO
UTAH LAKE

ALTERNATIVE NO. 4

MODIFY AND EXPAND EXISTING PLANTS AT EXISTING LOCATIONS. LEVEL IV TREATMENT AT LEHI, PLEASANT GROVE AND OREM. LEVEL III TREATMENT AT AMERICAN FORK WITH OUTFALL EXTENDED INTO LAKE.

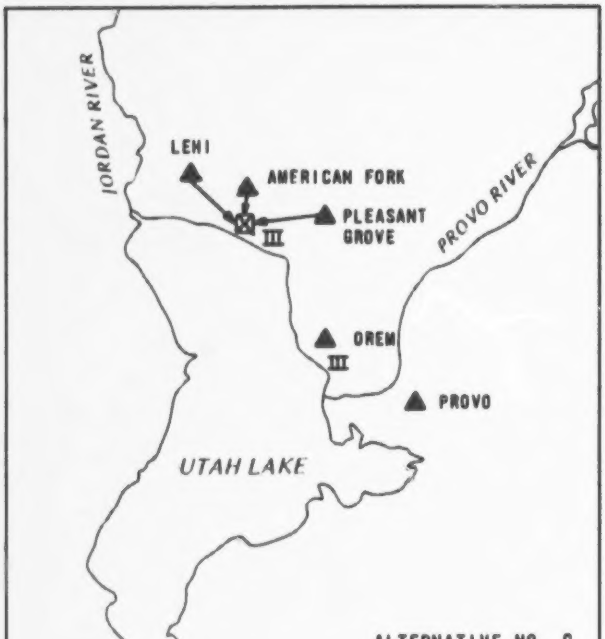
FIGURE IV-19 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - NORTHERN UTAH COUNTY


JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
IV
PROVO RIVER
OREM
IV
PROVO
UTAH LAKE

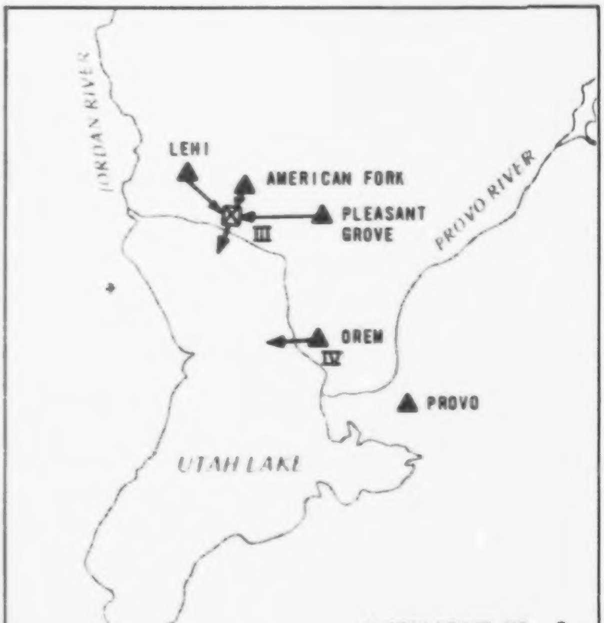
ALTERNATIVE NO. 5

CONVEY FLOWS FROM LEHI, PLEASANT GROVE AND AMERICAN FORK TO NEW REGIONAL PLANT NEAR AMERICAN FORK. OREM REMAINS SEPARATE. LEVEL IV TREATMENT AT ALL PLANTS.


JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
III
PROVO RIVER
OREM
III
PROVO
UTAH LAKE

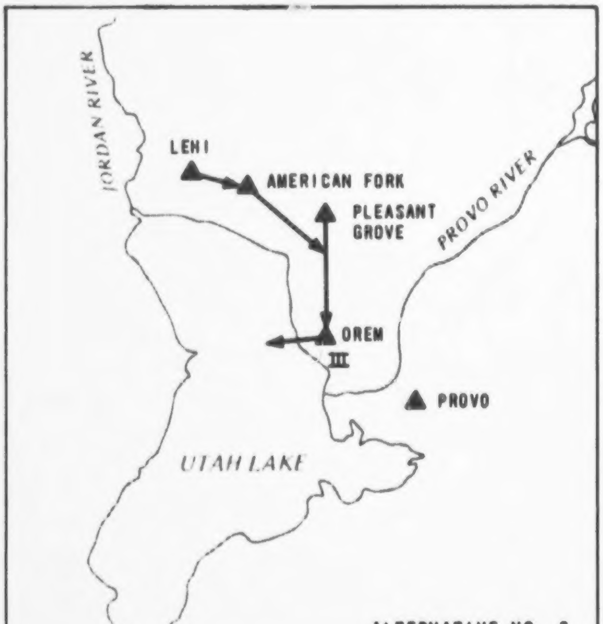
ALTERNATIVE NO. 6

AS ALTERNATIVE 5, BUT LEVEL III TREATMENT ....


JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
III
PROVO RIVER
OREM
IV
PROVO
UTAH LAKE

ALTERNATIVE NO. 7

CONVEY FLOWS FROM LEHI, PLEASANT GROVE AND AMERICAN FORK TO NEW REGIONAL PLANT NEAR AMERICAN FORK. OREM REMAINS SEPARATE. LEVEL III TREATMENT WITH OUTFALLS TO LAKE FROM OREM AND REGIONAL PLANT

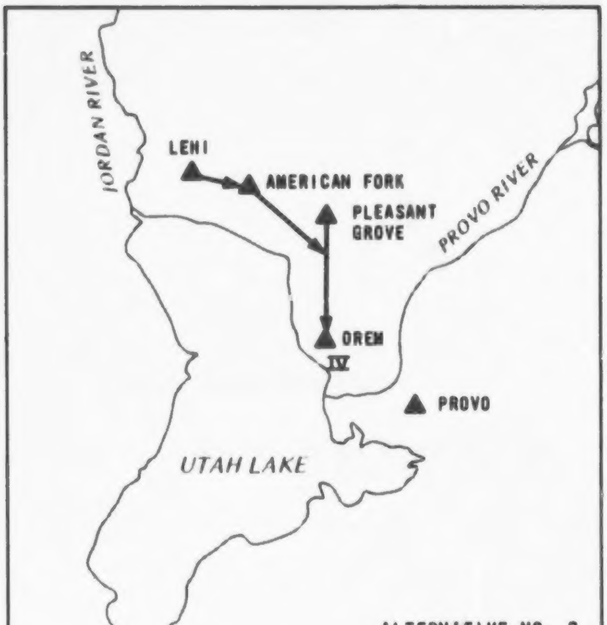

JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
OREM
III
PROVO
UTAH LAKE

ALTERNATIVE NO. 8

CONVEY FLOWS FROM LEHI, PLEASANT GROVE AND AMERICAN FORK TO EXPANDED OREM PLANT. IMPLEMENT TREATMENT LEVEL III WITH LAKE OUTFALL

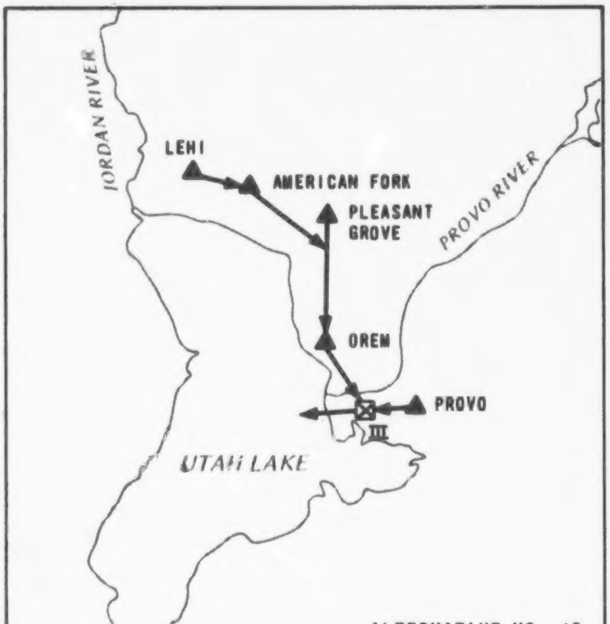
FIGURE IV-19 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - NORTHERN UTAH COUNTY


JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
OREM
IV
PROVO
UTAH LAKE

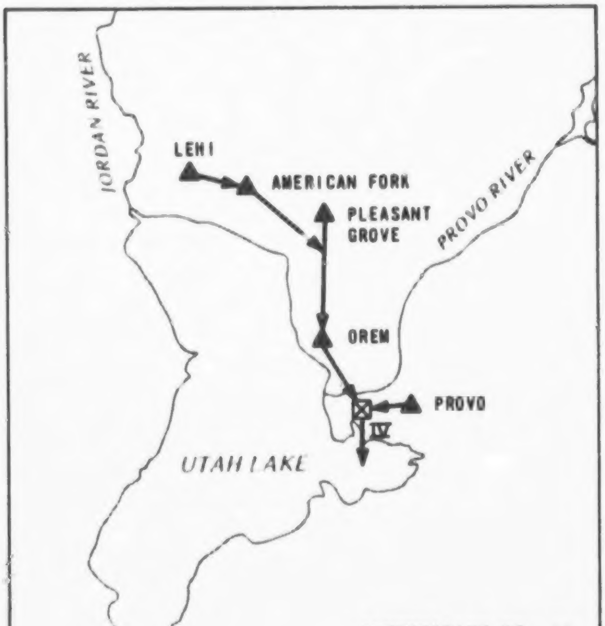
ALTERNATIVE NO. 9

SAME AS ALTERNATIVE 8, BUT WITH LEVEL IV TREATMENT AT OREM PLANT. DISCHARGE TO SLOUGH.


JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
OREM
PROVO
III
UTAH LAKE

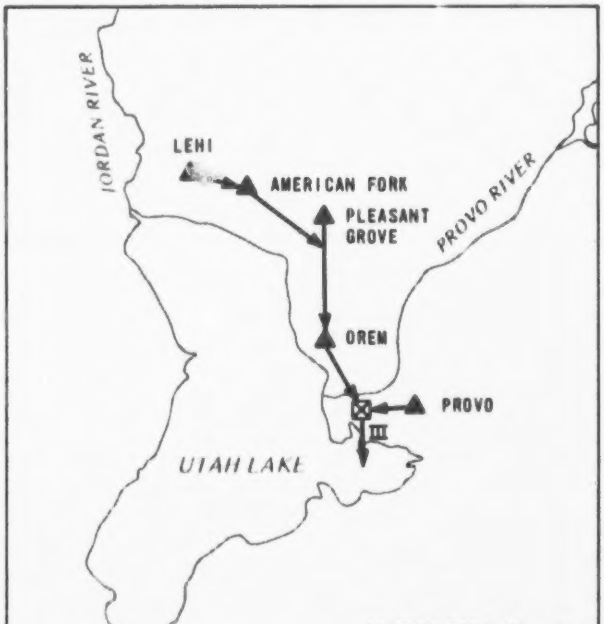
ALTERNATIVE NO. 10

CONVEY FLOWS FROM LEHI, PLEASANT GROVE, AMERICAN FORK AND OREM TO NEW REGIONAL PLANT NEAR PROVO. TREATMENT LEVEL III WITH LAKE OUTFALL.


JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
OREM
PROVO
IV
UTAH LAKE

ALTERNATIVE NO. 11

SAME AS ALTERNATIVE 10, BUT WITH LEVEL IV TREATMENT AT NEW REGIONAL PLANT NEAR PROVO. DISCHARGE TO PROVO BAY.


JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
PROVO RIVER
OREM
PROVO
III
UTAH LAKE

ALTERNATIVE NO. 12

AS ALTERNATIVE 11, BUT WITH LEVEL III TREATMENT......

FIGURE IV-19 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - NORTHERN UTAH COUNTY

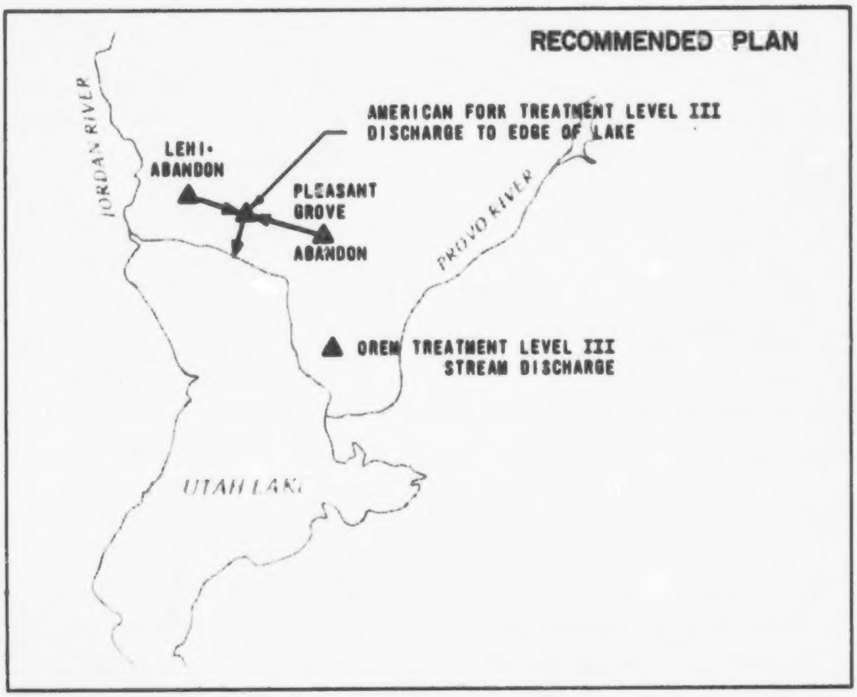

RECOMMENDED PLAN
AMERICAN FORK TREATMENT LEVEL III
DISCHARGE TO EDGE OF LAKE
LEHI-
ABANDON
PLEASANT
GROVE
ABANDON
JORDAN RIVER
PROVO RIVER
OREM TREATMENT LEVEL III
STREAM DISCHARGE
UTAH LAKE

TABLE IV-5

COST ANALYSIS FOR NORTHERN UTAH COUNTY

Categories of Alternatives	Capital Cost ($$10^6$)	Annual Operation & Maintenance Cost ($$10^6$/Yr)	Annual Cost Per Capita ($/Cap/Yr)
Level III Alternatives			
NUC-2	6.28	0.63	17.04
NUC-3	9.05	0.63	19.83
NUC-6	8.61	0.52	18.02
NUC-7	10.11	0.52	19.55
NUC-8	9.65	0.30	17.46
NUC-10	Alternative not currently valid.		
NUC-12	Alternative not currently valid.		
Level IV Alternatives			
NUC-1	13.01	0.84	29.05
NUC-5	14.91	0.74	29.47
NUC-9	14.18	0.66	26.96
NUC-11	Alternative not currently valid.		
Levels III & IV Alternatives			
NUC-4	12.73	0.82	28.21
Recommended Plan			
Level III	8.61	0.52	18.02
Secondary	5.31	0.26	9.92

FIGURE IV-20

BOD WASTE LOADS - NORTHERN UTAH COUNTY

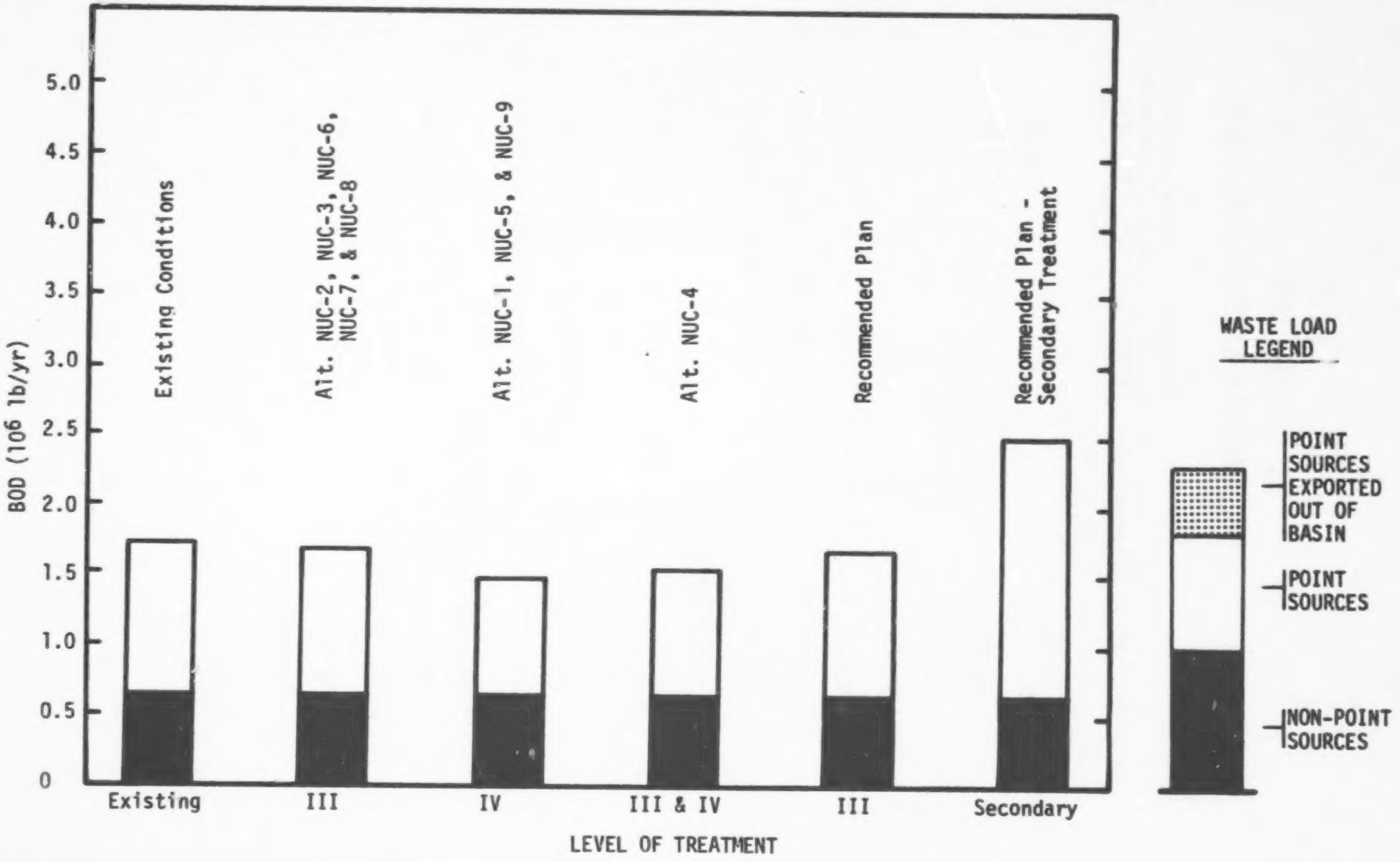


FIGURE IV-21

TDS WASTE LOADS - NORTHERN UTAH COUNTY

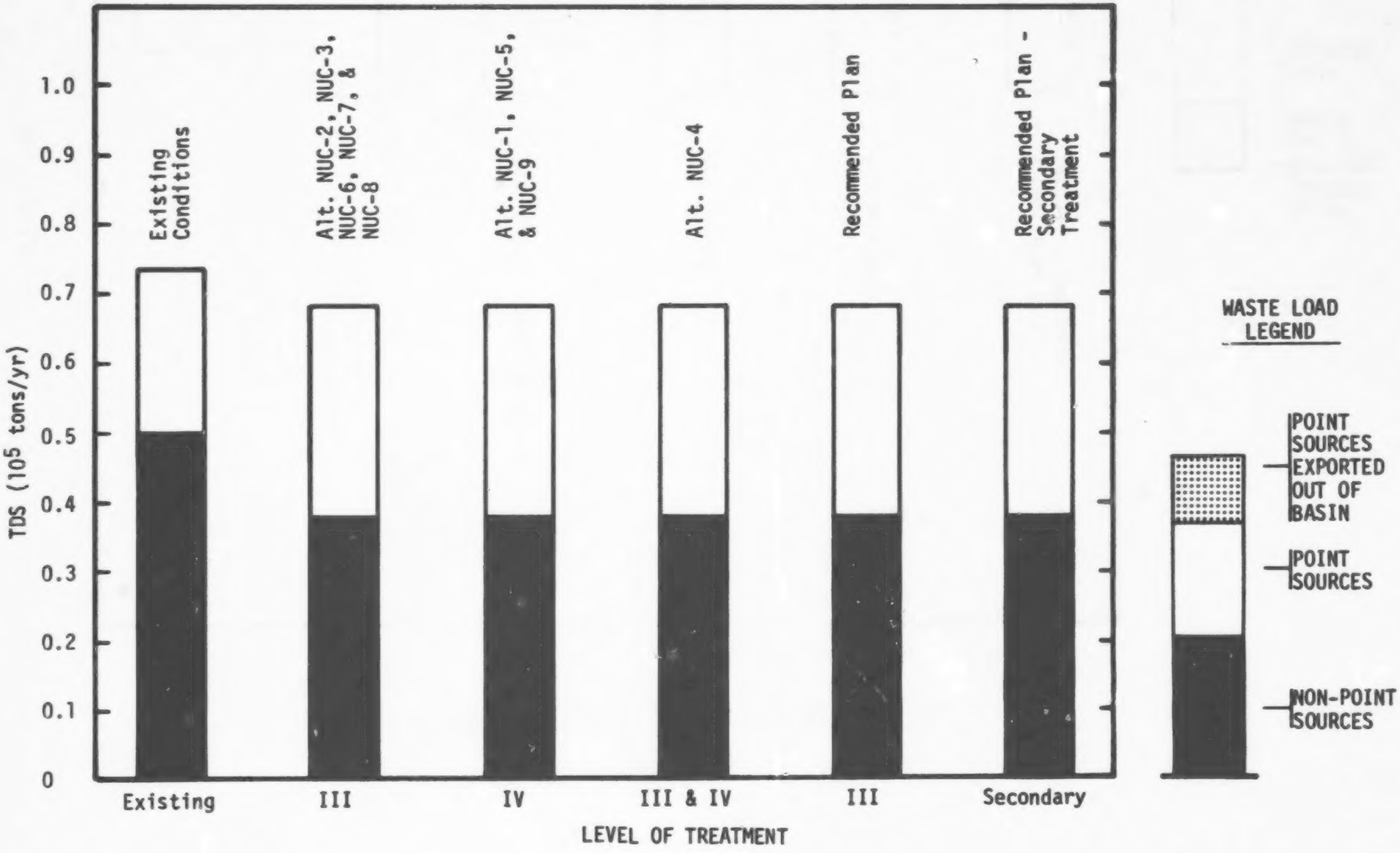
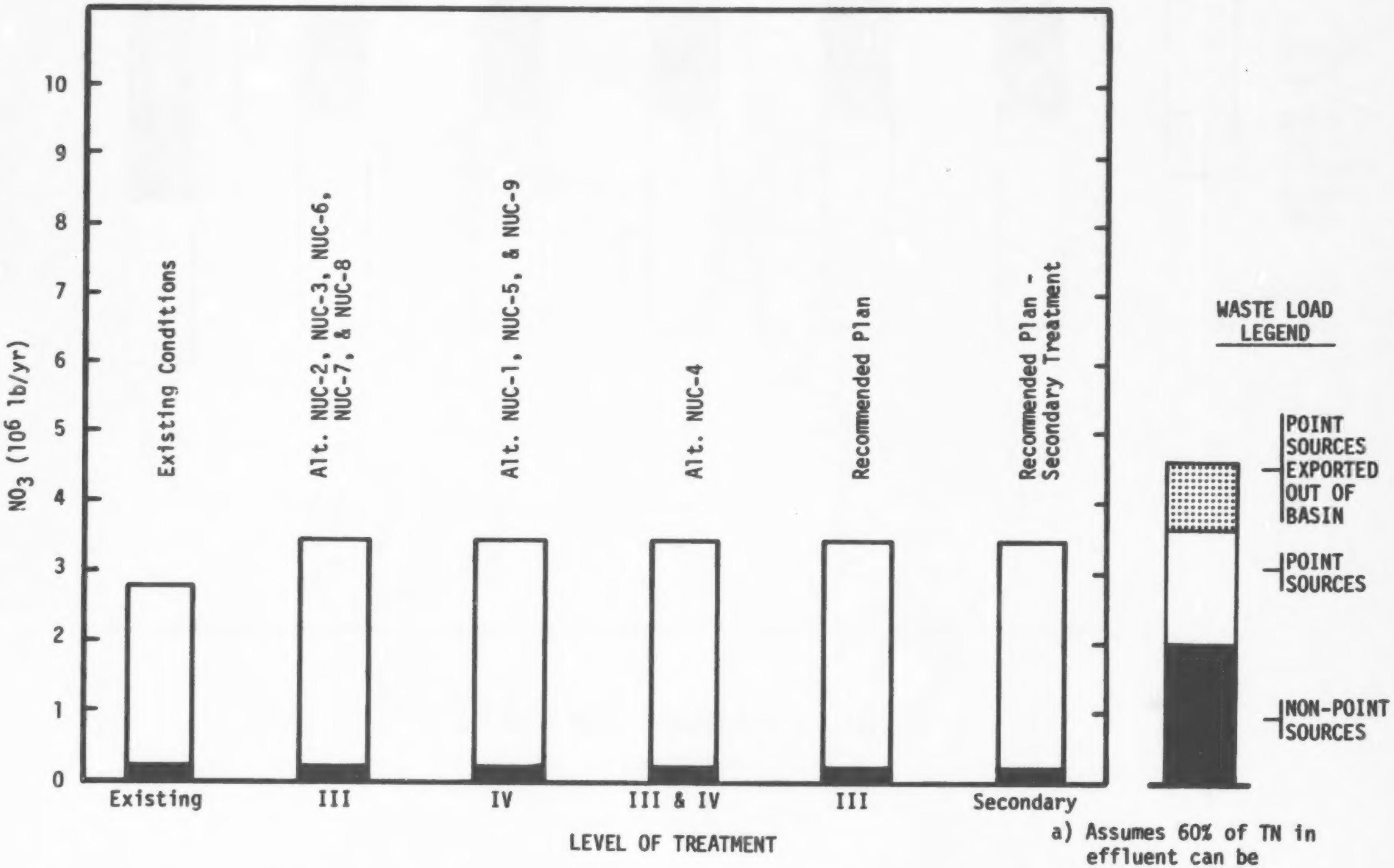


FIGURE IV-22

[a] NO_3 WASTE LOADS - NORTHERN UTAH COUNTY



[a] Assumes 60% of TN in effluent can be converted to NO_3.

FIGURE IV-23

PO_4 WASTE LOADS - NORTHERN UTAH COUNTY

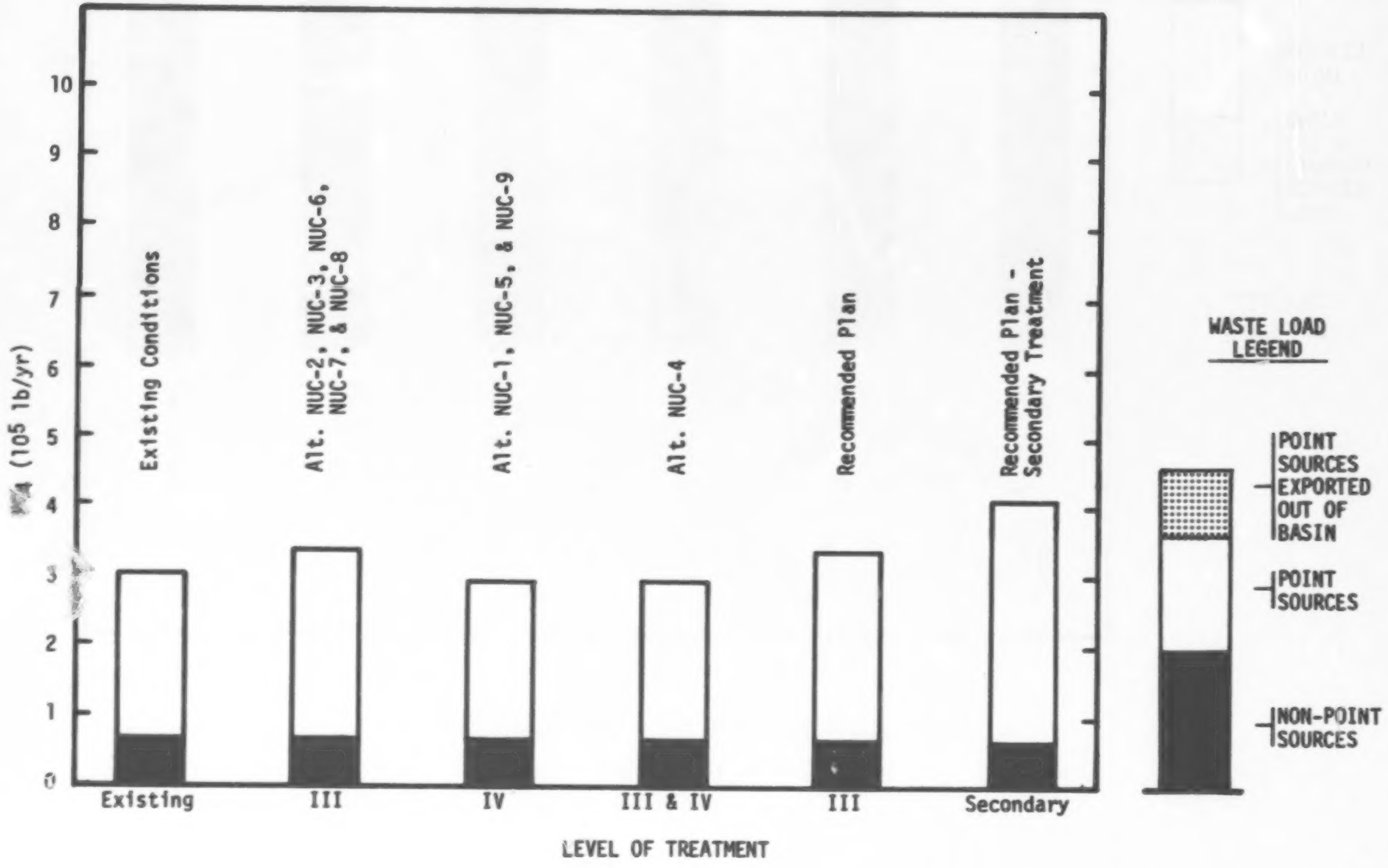
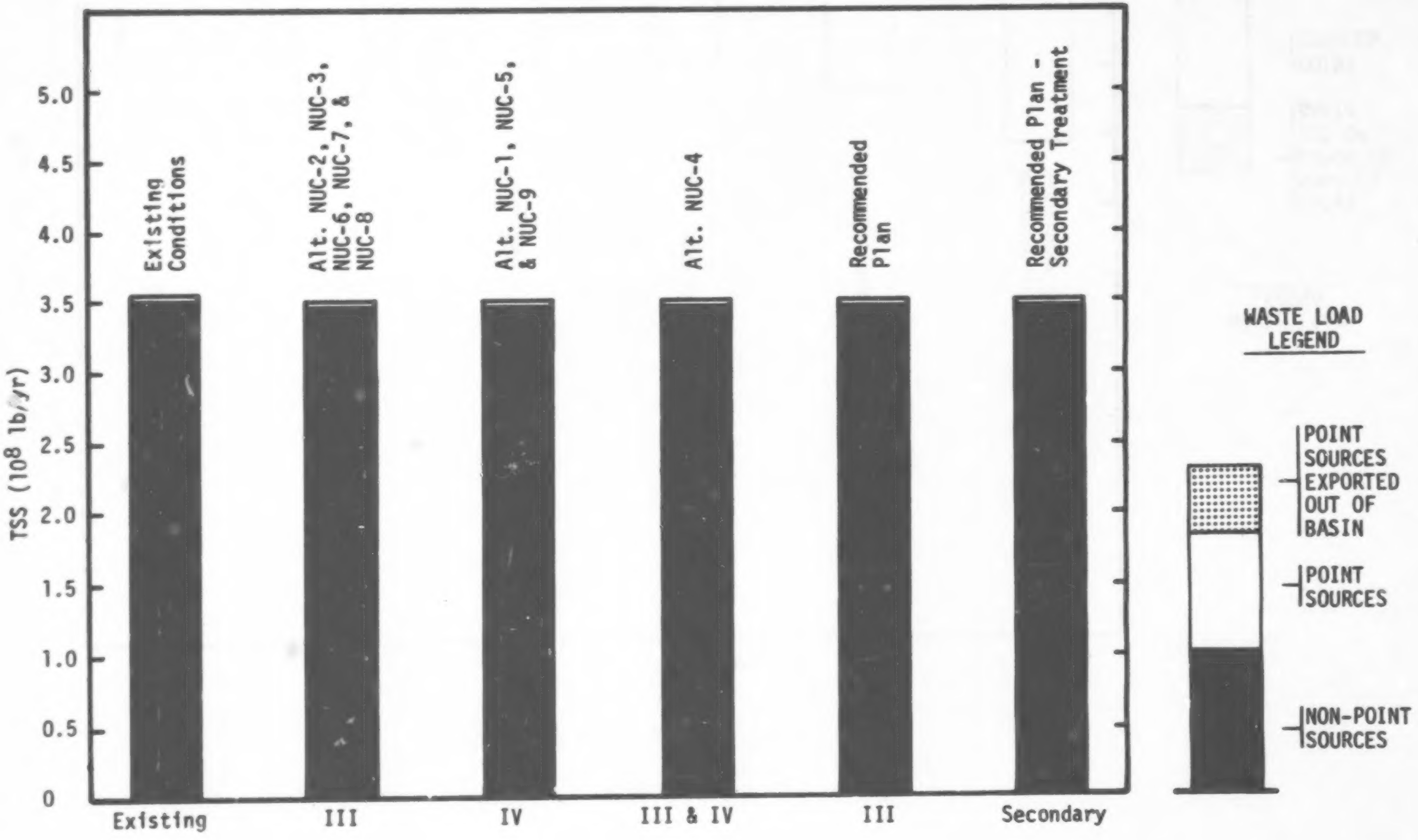


FIGURE IV-24

TSS WASTE LOADS - NORTHERN UTAH COUNTY



Industrial waste loads of BOD amount to nearly 700,000 pounds per year or approximately 40 percent of the total BOD loading. PO_4 waste loads for existing conditions, Level III and Level IV alternatives fluctuate around 300,000 pounds per year. Only a ten percent reduction in the total PO_4 waste load is realized if Level IV treatment is implemented rather than Level III, again because of population increase. Both BOD and PO_4 waste loads would increase significantly over the existing conditions if secondary treatment was utilized.

Coliform bacteria loadings from point sources can be expected to decrease under all future alternatives because of the strict effluent limitations on coliform bacteria for all levels of treatment considered.

Aquatic Impact

The aquatic impacts associated with wastewater treatment alternatives in Northern Utah County are related to Utah Lake because treatment plants and industrial sources discharge close to or directly to the Lake. Based on this and because the total BOD waste loading is only slightly reduced for Level III and Level IV alternatives, no significant increase in the DO of Utah Lake should result. For alternatives containing recommendations for regionalization, increased flows may impose some localized DO reductions; however, the mean DO concentration in Utah Lake in the Northern Utah County area ranges from 6.0 to 8.0 mg/l well above the Utah state Standard of 5.5 mg/l for warm water fisheries. Utah Lake is currently a nitrogen-deficient system. As such, minor reductions or increase in phosphates waste loads should have little impact on the ecosystem. However, increases in nitrogen may cause algal blooms and other nuisance aquatic growths. It should be noted that the highest concentrations of nitrates occur adjacent to the Geneva Steel Works.

Summary

The following observations are made regarding the costs, waste loads, and aquatic impacts associated with wastewater treatment alternatives in Northern Utah County:

- Alternatives NUC-10, NUC-11, and NUC-12 are not considered viable alternatives because EPA is currently partially funding a 22.9 million dollar wastewater treatment program in Provo.
- At Level III, Alternatives NUC-2, NUC-6, and NUC-8, and the recommended plan are all equally cost effective.
- At Level IV, Alternative NUC-9 is the most cost effective.
- The recommended plan with secondary treatment has an associated cost of only 55 percent of the recommended plan at Level III.
- Non-point sources are significant sources of BOD, TDS, and TSS.
- Industrial sources are significant sources of BOD and NO_3.
- Because Utah Lake is a nitrogen deficient system, increases in NO_3 may cause algal blooms and nuisance aquatic growths.
- Total waste loads in Northern Utah County should remain fairly constant with only minor changes due to non-point sources. These changes will be the result of changes in land use.

CENTRAL UTAH COUNTY

Central Utah County is comprised of those areas drained by the Lower Provo River, Hobble Creek and the Spanish Fork River. Provo is the major population center with remaining populations located in Springville, Spanish Fork, Salem, and Payson. The alternatives considered in the Plan include various degrees of regionalization at various levels of treatment. These alternatives, presented in Figure IV-25, are divided into three distinct groups:

- all plants at Level III treatment
- all plants at Level IV treatment
- a combination of Level III and Level IV treatment plants.

Level III alternatives are CUC-2, CUC-4, CUC-6, CUC-7, CUC-9, CUC-10, and CUC-12. Level IV alternatives are CUC-1, CUC-3, CUC-5, and CUC-11. Only CUC-8 considers two levels of treatment.

Cost Analysis

The costs associated with each alternative are presented in Table IV-6. For Level III alternatives, the least expensive plans are CUC-6 ($24.31/cap/year), CUC-12 ($24.31/cap/year), and the recommended plan ($24.22/cap/year). If Level IV treatment is recommended, CUC-5 ($35.69/cap/year) and CUC-11 ($35.00/cap/year) are the cheapest. It should be noted that because of the existing program for upgrading and expanding the Provo treatment facility to Level III treatment, the costs and capacity associated with this program are utilized in the economic analysis. This upgrading and expansion includes additional capacity to accommodate the recommended plan. For these reasons, the recommended plan at secondary treatment was not evaluated for Central Utah County.

Waste Load Analysis

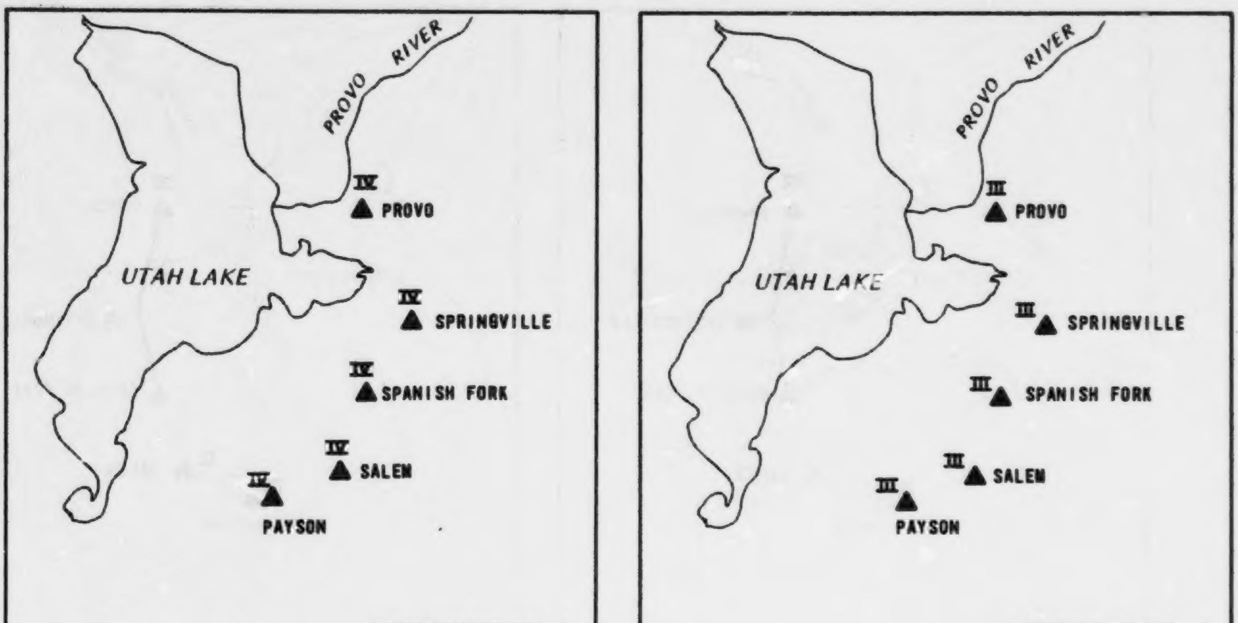
Waste loads tributary to Utah Lake and originating in the drainage areas of Central Utah County have been developed for point and non-point sources and are illustrated in Figures IV-26 through IV-30. As in Northern Utah County, Nitrate (NO_3) is used instead of Total Nitrogen (TN).

Non-point and industrial sources comprise 87 to 94 percent of the total BOD waste load in Central Utah County. Therefore, any change in municipal wastewater loadings amounts to only a small change in the overall BOD waste load in the area. Although Total Suspended Solids (TSS) waste loads are significantly different at different levels of treatment, non-point sources account for over 99 percent of the total waste load and, therefore, overshadow any TSS reduction attributable to advanced treatment processes. Similarly, approximately 45 percent of the total Phosphate (PO_4) waste load is attributable to non-point sources, which greatly reduces the overall effect of advanced wastewater treatment.

In consideration of the impact of current plans to implement Level III treatment at Provo, significant non-point contributions, and industrial sources, the total future waste loads for the parameters considered are not significantly different for any alternative. Moreover, total future waste loads either do not change significantly or increase when compared to existing conditions.

FIGURE IV-25

WASTEWATER TREATMENT ALTERNATIVES - CENTRAL UTAH COUNTY

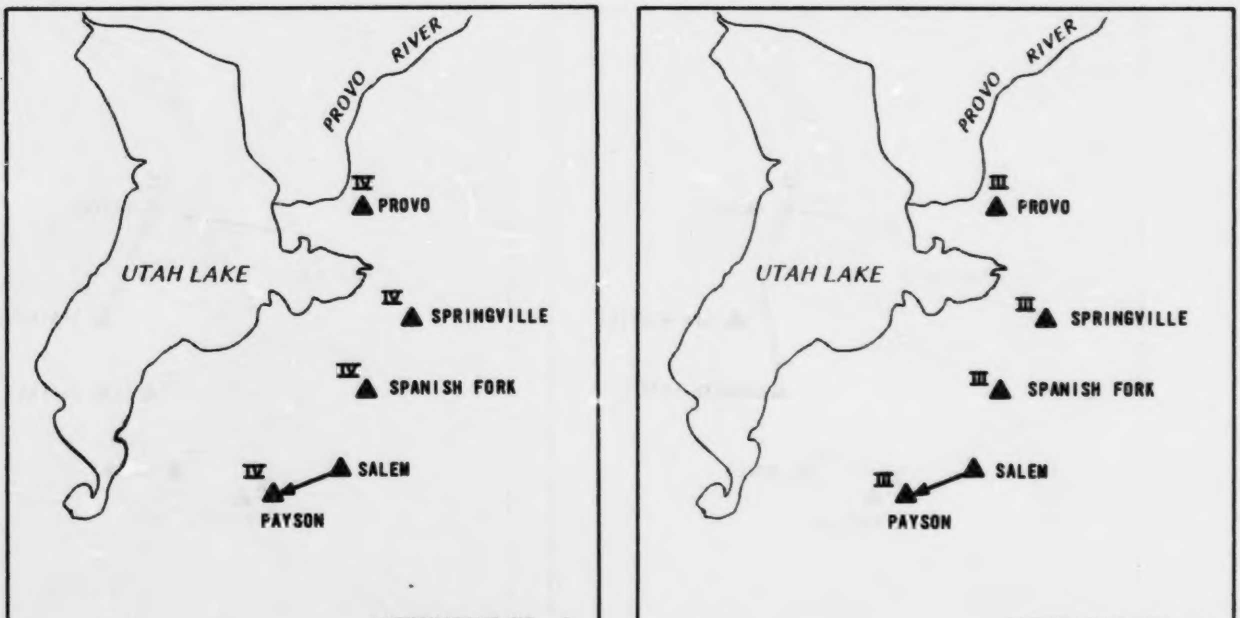

PROVO RIVER
UTAH LAKE
IV PROVO
IV SPRINGVILLE
IV SPANISH FORK
IV SALEM
IV PAYSON
PROVO RIVER
UTAH LAKE
III PROVO
III SPRINGVILLE
III SPANISH FORK
III SALEM
III PAYSON

ALTERNATIVE NO. 1

MODIFY AND EXPAND EXISTING PLANTS AT EXISTING LOCATIONS. TREATMENT LEVEL IV.

ALTERNATIVE NO. 2

AS ALTERNATIVE 1, BUT LEVEL III TREATMENT............


PROVO RIVER
UTAH LAKE
IV PROVO
IV SPRINGVILLE
IV SPANISH FORK
SALEM
IV PAYSON
PROVO RIVER
UTAH LAKE
III PROVO
III SPRINGVILLE
III SPANISH FORK
SALEM
III PAYSON

ALTERNATIVE NO. 3

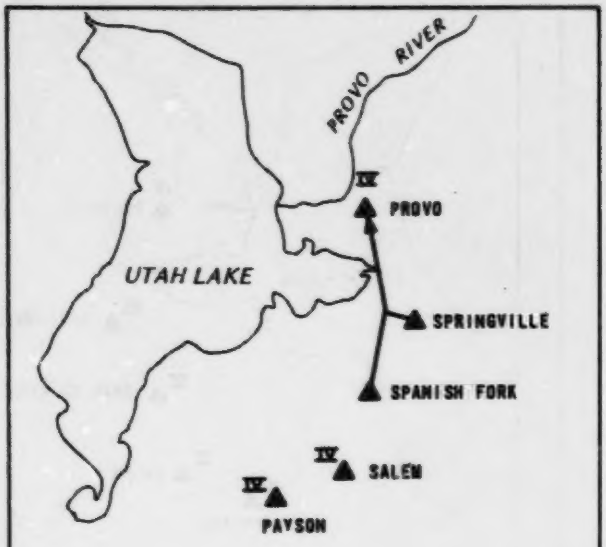
MODIFY AND EXPAND EXISTING PLANTS AT EXISTING LOCATIONS. CONVEY FLOWS FROM SALEM TO PAYSON. TREATMENT LEVEL IV.

ALTERNATIVE NO. 4

AS ALTERNATIVE 3, BUT LEVEL III TREATMENT............

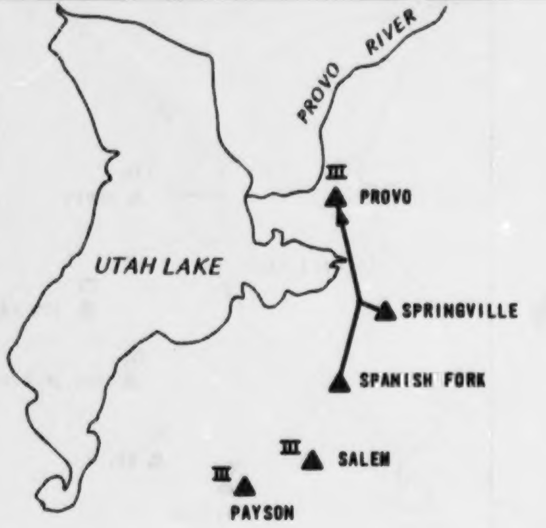
FIGURE IV-25 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - CENTRAL UTAH COUNTY


PROVO RIVER
IV
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
IV
SALEM
IV
PAYSON

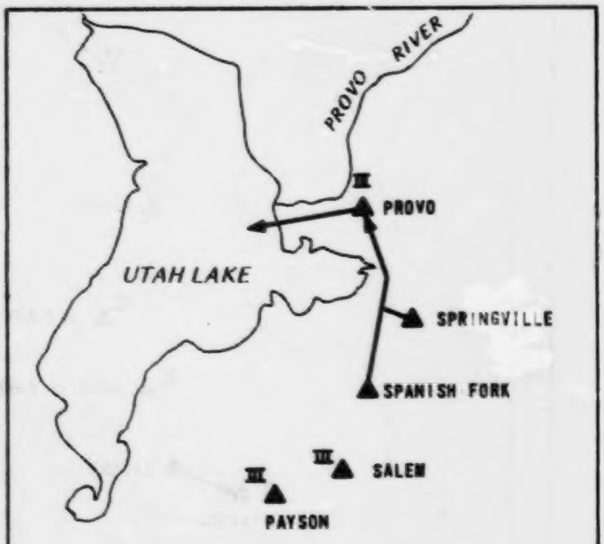
ALTERNATIVE NO. 5

CONVEY FLOWS FROM SPANISH FORK AND SPRINGVILLE TO EXPANDED PROVO PLANT. SALEM AND PAYSON PLANTS REMAIN AT EXISTING LOCATIONS. LEVEL IV TREATMENT.


PROVO RIVER
III
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
III
SALEM
III
PAYSON

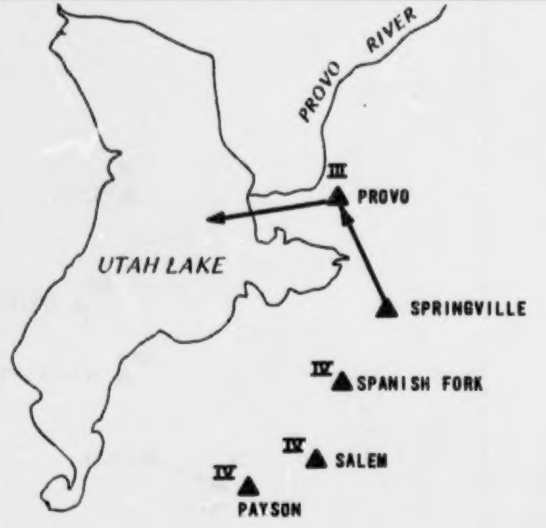
ALTERNATIVE NO. 6

AS ALTERNATIVE 5, BUT LEVEL III TREATMENT............


PROVO RIVER
III
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
III
SALEM
III
PAYSON

ALTERNATIVE NO. 7

CONVEY FLOWS FROM SPANISH FORK AND SPRINGVILLE TO EXPANDED PROVO PLANT. LEVEL III TREATMENT, LAKE OUTFALL. SALEM AND PAYSON REMAIN AT PRESENT LOCATIONS WITH LEVEL III TREATMENT.

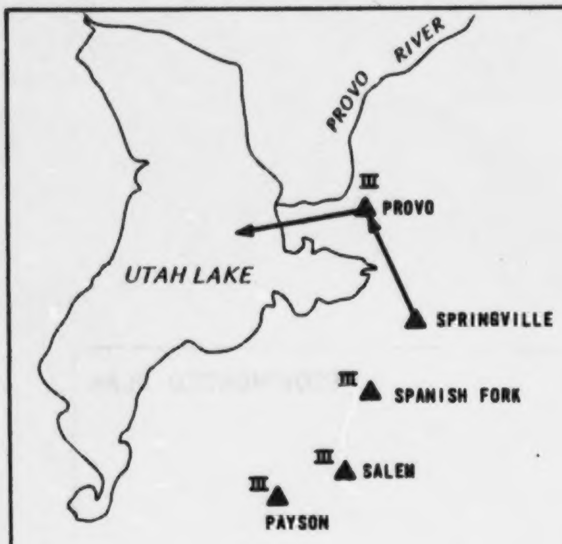

PROVO RIVER
III
PROVO
UTAH LAKE
SPRINGVILLE
IV
SPANISH FORK
IV
SALEM
IV
PAYSON

ALTERNATIVE NO. 8

CONVEY FLOW FROM SPRINGVILLE TO PROVO; LEVEL III TREATMENT WITH LAKE OUTFALL. SPANISH FORK, PAYSON AND SALEM REMAIN SEPARATE. LEVEL IV TREATMENT.

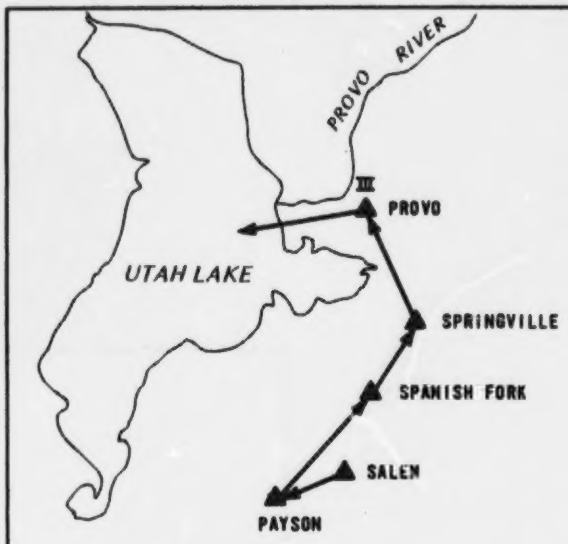
FIGURE IV-25 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - CENTRAL UTAH COUNTY


PROVO RIVER
III
PROVO
UTAH LAKE
SPRINGVILLE
III
SPANISH FORK
III
SALEM
III
PAYSON

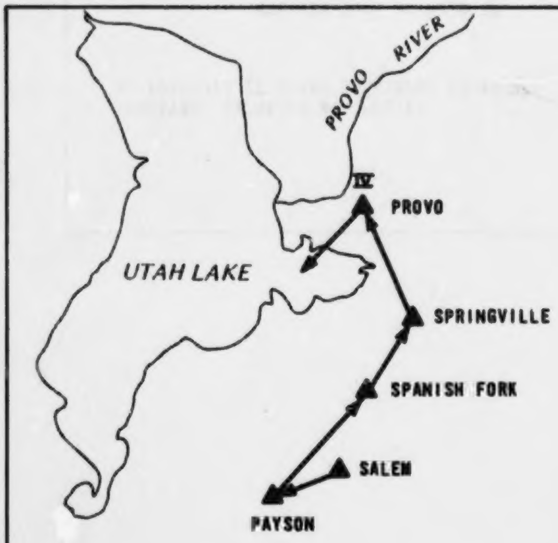
ALTERNATIVE NO. 9

AS ALTERNATIVE 8, BUT LEVEL III TREATMENT AT ALL PLANTS.


PROVO RIVER
III
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
SALEM
PAYSON

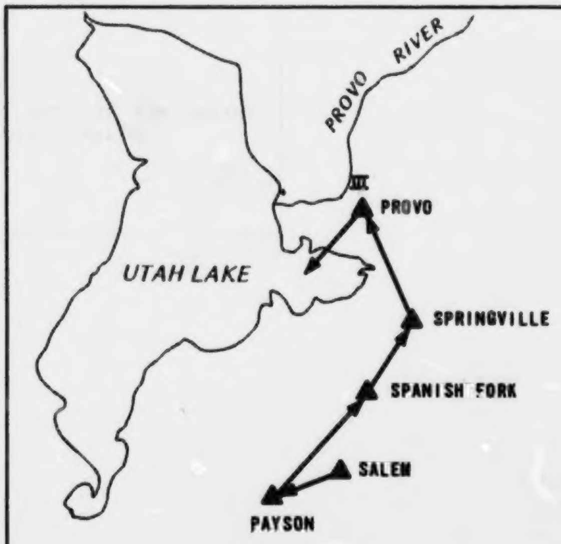
ALTERNATIVE NO. 10

CONVEY FLOWS FROM SPANISH FORK, SPRINGVILLE, SALEM AND PAYSON TO EXPANDED PROVO PLANT. LEVEL III TREATMENT, LAKE OUTFALL.


PROVO RIVER
IV
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
SALEM
PAYSON

ALTERNATIVE NO. 11

CONVEY FLOWS FROM SPANISH FORK, SPRINGVILLE, SALEM AND PAYSON TO EXPANDED PROVO PLANT. LEVEL IV TREATMENT; DISCHARGE TO PROVO BAY.


PROVO RIVER
III
PROVO
UTAH LAKE
SPRINGVILLE
SPANISH FORK
SALEM
PAYSON

ALTERNATIVE NO. 12

AS ALTERNATIVE 11, BUT LEVEL III TREATMENT.

FIGURE IV-25 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - CENTRAL UTAH COUNTY

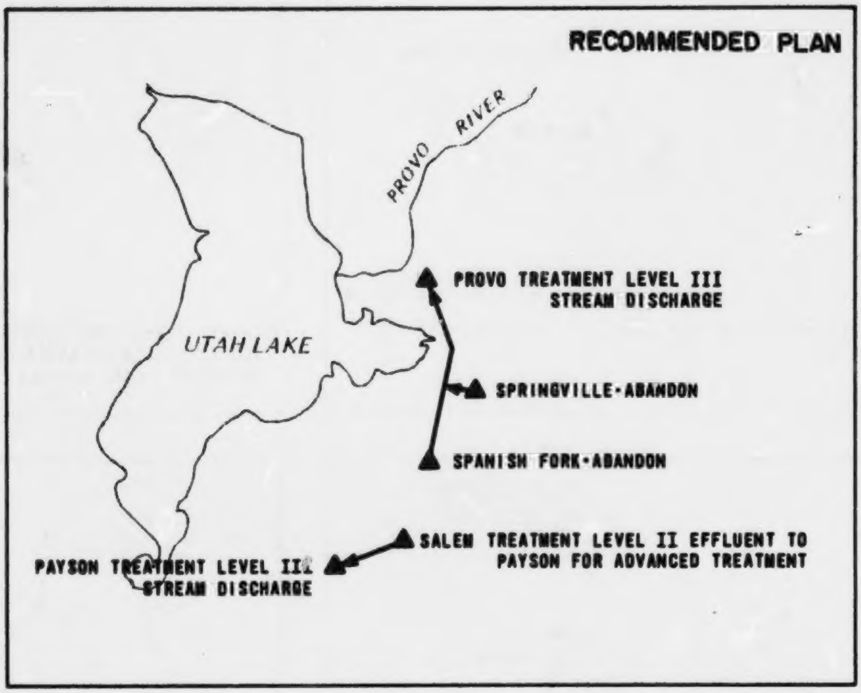

RECOMMENDED PLAN
PROVO RIVER
UTAH LAKE
PROVO TREATMENT LEVEL III STREAM DISCHARGE
SPRINGVILLE-ABANDON
SPANISH FORK-ABANDON
SALEM TREATMENT LEVEL II EFFLUENT TO PAYSON FOR ADVANCED TREATMENT
PAYSON TREATMENT LEVEL III STREAM DISCHARGE

TABLE IV-6

COST ANALYSIS FOR CENTRAL UTAH COUNTY

Categories of Alternatives	Capital Cost ($\$10^6$)	Annual Operation & Maintenance Cost ($\$10^6$/Yr)	Annual Cost Per Capita ($/Cap/Yr)
Level III Alternatives			
CUC-2	18.33	1.00	26.66
CUC-4	18.71	0.97	26.56
CUC-6	19.01	0.74	24.31
CUC-7	21.96	0.79	26.86
CUC-9	21.42	0.88	27.44
CUC-10	23.43	0.68	26.67
CUC-12	20.48	0.64	24.31
Level IV Alternatives			
CUC-1	29.31	1.43	41.02
CUC-3	29.64	1.42	41.11
CUC-5	27.54	1.09	35.69
CUC-11	28.28	0.99	35.00
Levels III & IV Alternative			
CUC-8	23.20	0.92	29.49
Recommended Plan			
Level III	19.39	0.71	24.22

FIGURE IV-26

BOD WASTE LOADS - CENTRAL UTAH COUNTY

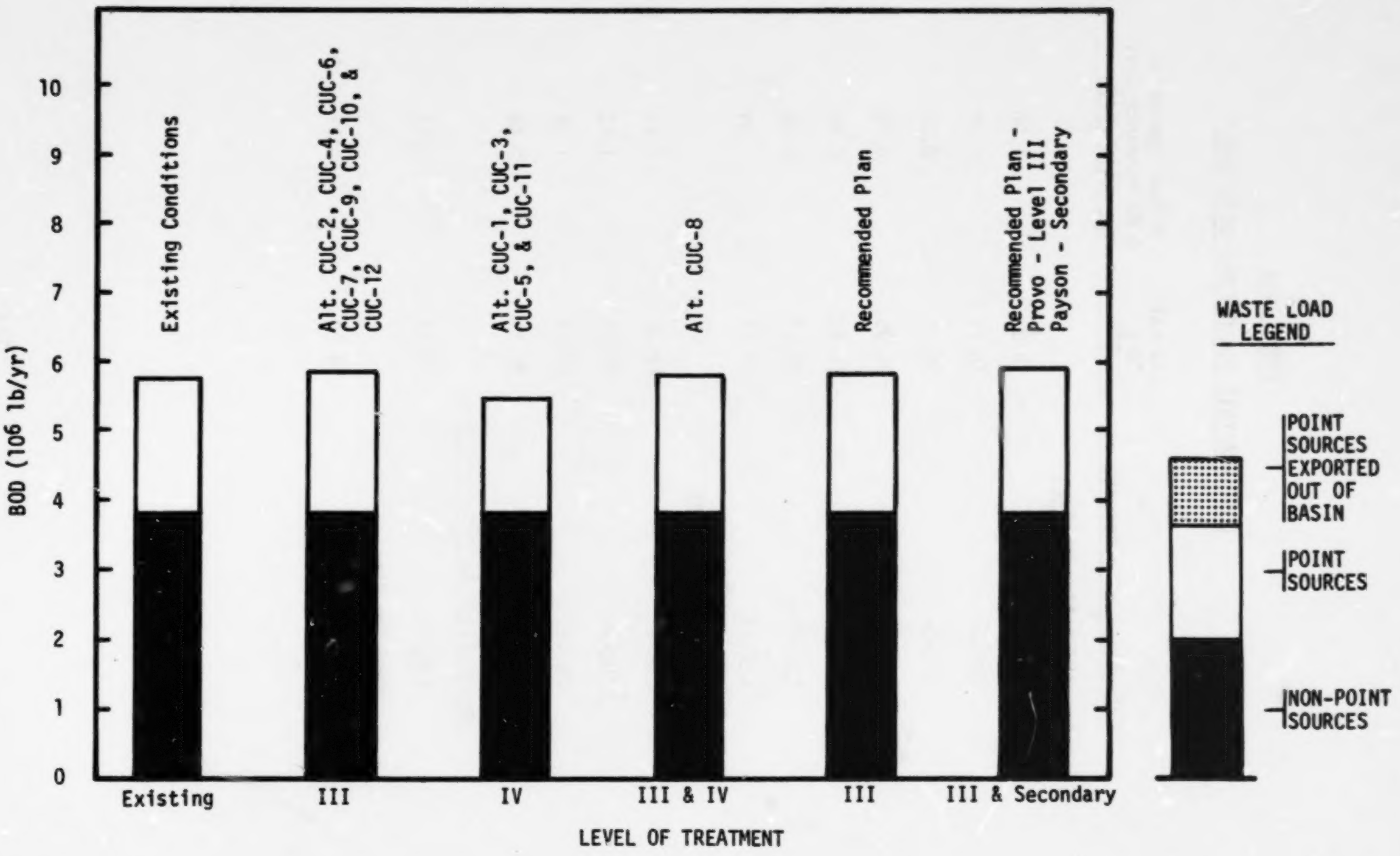


FIGURE IV-27

TDS WASTE LOADS - CENTRAL UTAH COUNTY

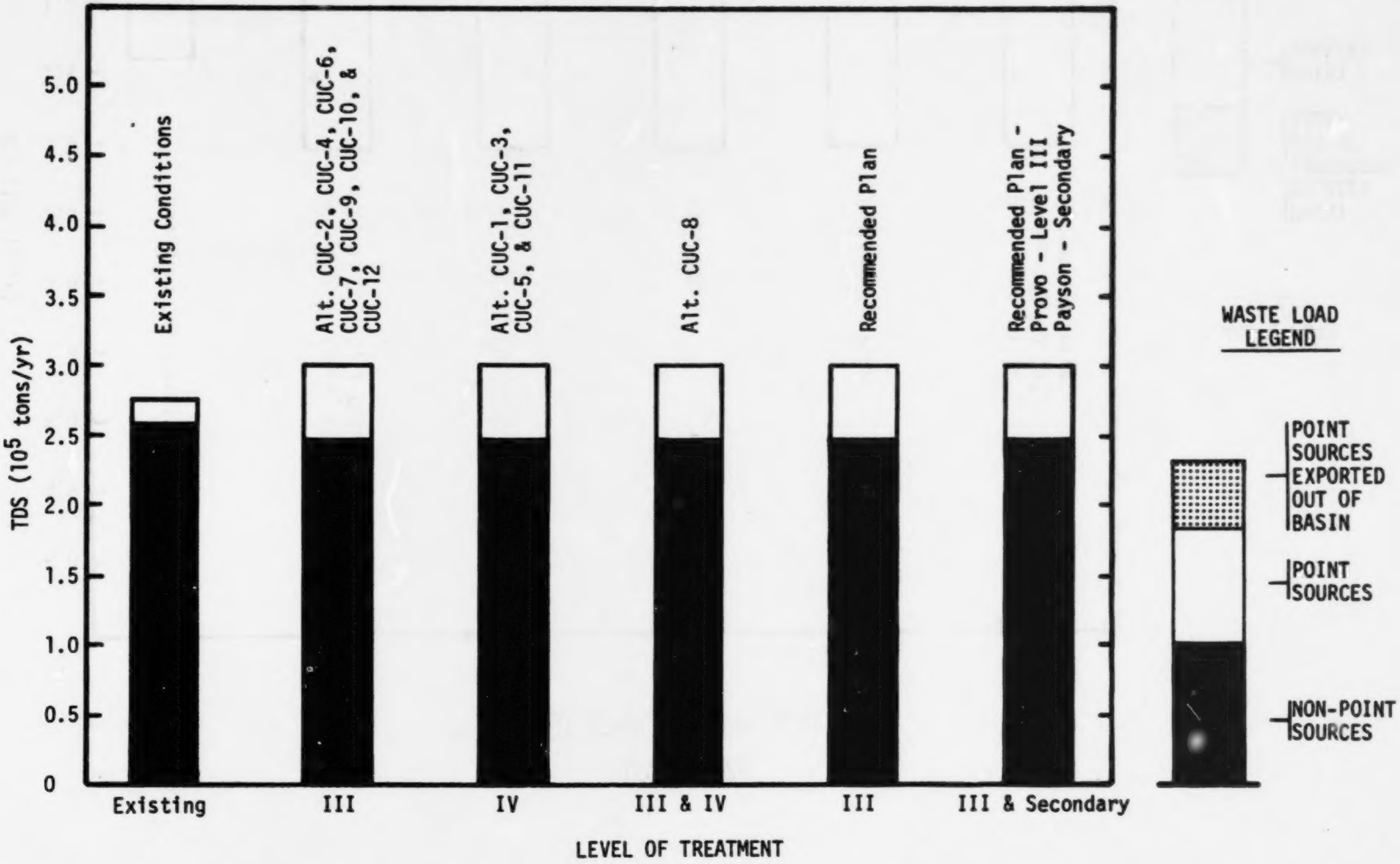
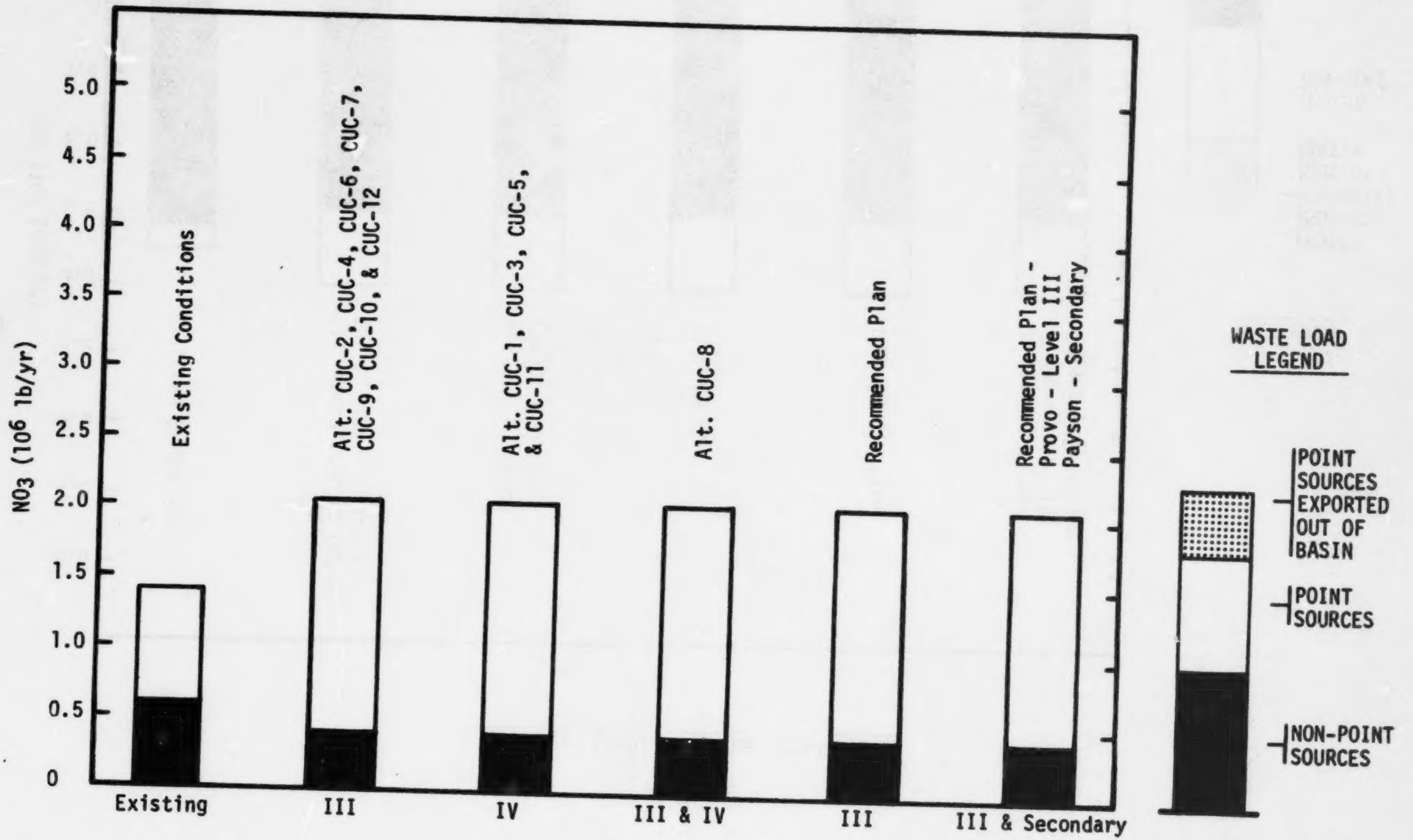


FIGURE IV-28

[a] NO_3 WASTE LOADS - CENTRAL UTAH COUNTY



a) Assumes 60% of TN in effluent can be converted to NO_3

FIGURE IV-29

PO_4 WASTE LOADS - CENTRAL UTAH COUNTY

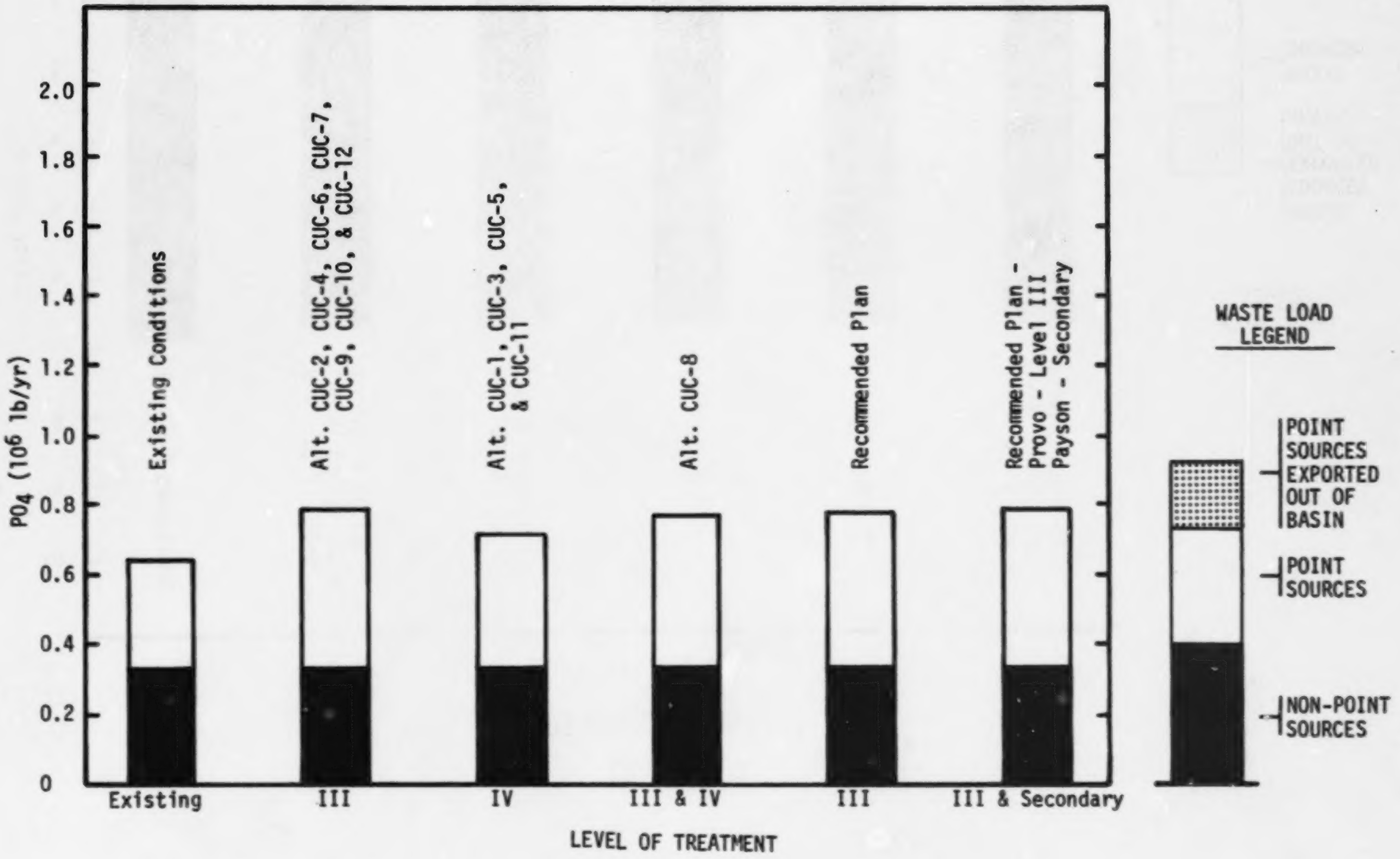
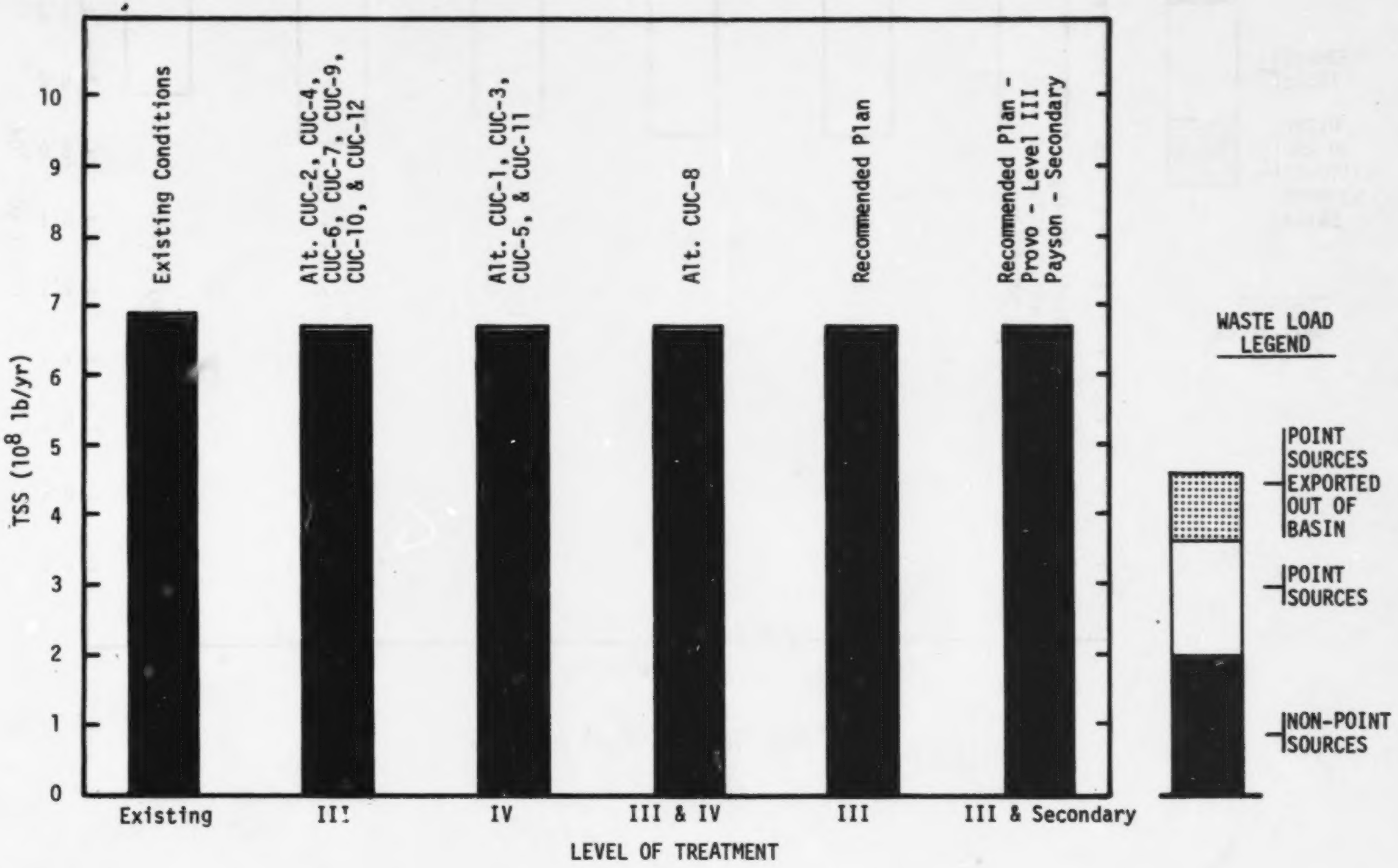


FIGURE IV-30

TSS WASTE LOADS - CENTRAL UTAH COUNTY



Coliform bacteria loadings from point sources can be expected to decrease under all future alternatives because of the strict effluent limitations on coliform bacteria for all levels of treatment considered.

Aquatic Impacts

Based on the water quality data presented in Chapter III, the following statements regarding Utah Lake's aquatic ecosystem can be made:

1. Provo Bay has a distinctively different water quality than the remainder of Utah Lake. DO, BOD, Total Coliform, Phosphates, and NO_3 concentrations are historically higher in Provo Bay than the rest of Utah Lake which borders Central Utah County. Provo Bay is a highly productive system which can assimilate BOD, Phosphates, and NO_3 to form DO and/or food for higher life forms residing in the Bay. This assimilation of waste loads is essential not only to the Bay's productivity, but also to the productivity of the Lake itself.
2. Utah Lake has a nitrogen/phosphorus ratio of approximately 0.2 to 1.0. This low N/P ratio is indicative of a nitrogen deficient system and resulting inhibition of algal growth. A high observed turbidity in the Lake, which significantly reduces photosynthesis, also inhibits algal growth.

Thus, Provo Bay acts to reduce waste loads to the main body of Utah Lake. Within this context, it can be concluded that none of the alternatives appreciably reduce BOD waste loads to the extent which would enhance the existing aquatic habitat. Alternatives CUC-7, CUC-8, CUC-9, and CUC-10 contain a recommendation for a direct discharge to Utah Lake and this direct loading to the Lake may increase the potential for nuisance aquatic growths, because nutrients previously assimilated in Provo Bay would be available to the Lake. Spawning areas at the mouth of Provo Bay could be impacted by changes in water quality due to a Lake outfall, with a subsequent reduction in fish population and/or species. Additionally, a lake outfall can cause localized DO deficits in Utah Lake and/or drastically alter the ecosystem of Provo Bay by depriving it of essential nutrients.

Summary

Based on the previous discussions regarding costs, waste loads, and aquatic impacts of wastewater treatment alternatives for Central Utah County, the following observations are made:

- At Level III treatment, Alternatives CUC-6, CUC-12, and the recommended plan are all equally cost effective.
- At Level IV treatment, Alternatives CUC-5 and CUC-11 are both the most cost effective.
- An EPA funding program to expand and upgrade the Provo treatment facility is currently underway. This program calls for Level III treatment with sufficient capacity to accommodate the recommended plan.
- Future waste loads for all alternatives are identical or have only minimal differences for any single parameter considered.

- Provo Bay represents a valuable marshland which helps to assimilate waste loads imposed on Utah Lake.
- Because Utah Lake is a nitrogen deficient system, direct discharges via a lake outfall could contribute to algal blooms and nuisance aquatic growths.
- In general, if a lake outfall is constructed, the total nature of Utah Lake and Provo Bay may be adversely affected.

WASATCH COUNTY

Wasatch County is comprised of the upper Provo River drainage area tributary to Deer Creek Reservoir. The Heber and Midway wastewater treatment facilities are the only existing sewage works in the area. Six alternative treatment schemes, illustrated in Figure IV-31, are proposed for the area. These alternatives can be aggregated into three groups:

- Level III Alternatives (WC-2, WC-3, and WC-6)
- Level IV Alternatives (WC-1 and WC-5)
- Secondary treatment with subsequent land disposal (WC-4).

Cost Analysis

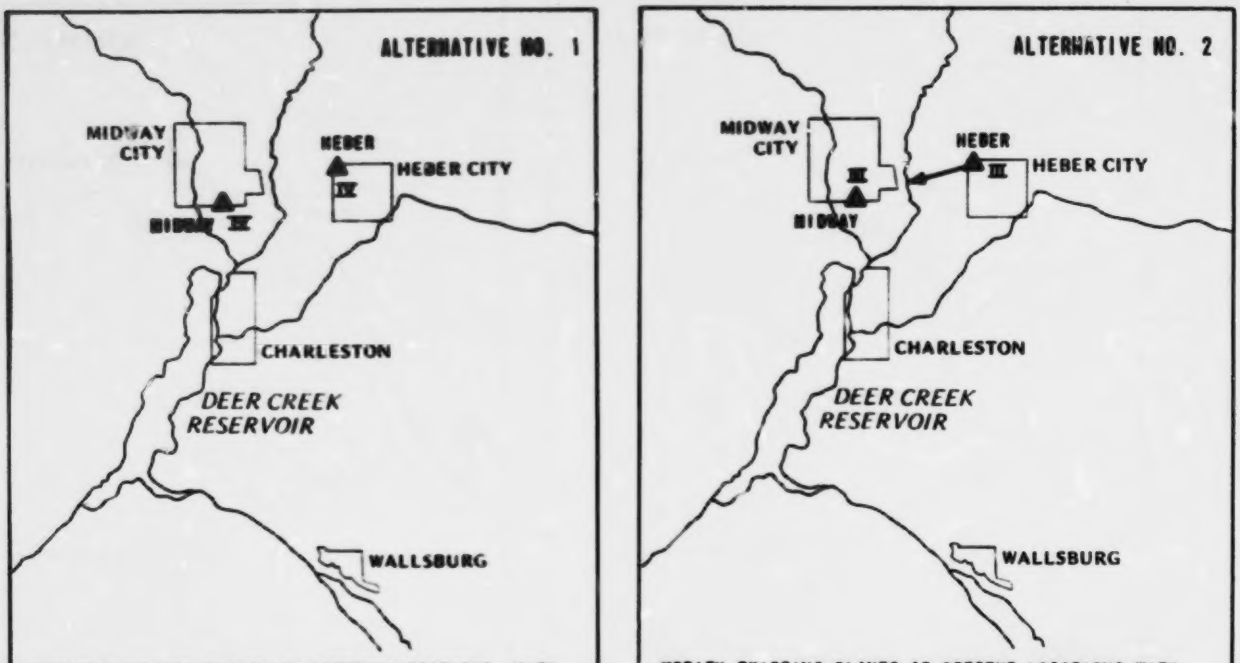
The costs associated with each of the treatment alternatives are presented in Table IV-7. Although representing vastly different treatment schemes, Alternatives WC-2, WC-4, and the recommended plan all have equal costs, $30.30/cap/year, which is the minimum cost for all alternatives considered. The recommended plan costs could be reduced by two-thirds if only secondary treatment was required. This large difference is due to the interceptor lines and capital and operation and maintenance cost for the advanced waste treatment at Charleston. If Level IV treatment was required, the most economical system would be WC-1 at $40.91/cap/year. Costs for WC-6, where all wastes would be exported from the basin to Provo are $50.00/cap/year for the interceptor (costs assigned to persons connected to the interceptor) and $32.30/cap/year for the Provo treatment plant (costs assigned to all persons connected to the plant) for a total cost of $82.30/cap/year.

Waste Load Analysis

Point and non-point waste loads for Wasatch County are illustrated in Figures IV-32 to IV-36. Non-point sources currently contribute between 56 and 98 percent of the total waste load for those parameters considered. Because future development is limited, the future non-point sources pollution is expected to be almost identical to existing conditions. In terms of total waste loadings, future BOD, Total Nitrogen (TN), and Phosphate (PO4) loads are less than existing conditions. However, the impact of advanced waste treatment on these reductions can be misleading. In actuality, future waste loads were estimated by assuming the massive infiltration/inflow problem in the Heber Valley would be resolved. Thus, even with more people, future waste flows and, hence, loadings are less than existing. It should also be noted that although future total area waste loads are less than existing loadings, where these wastes are

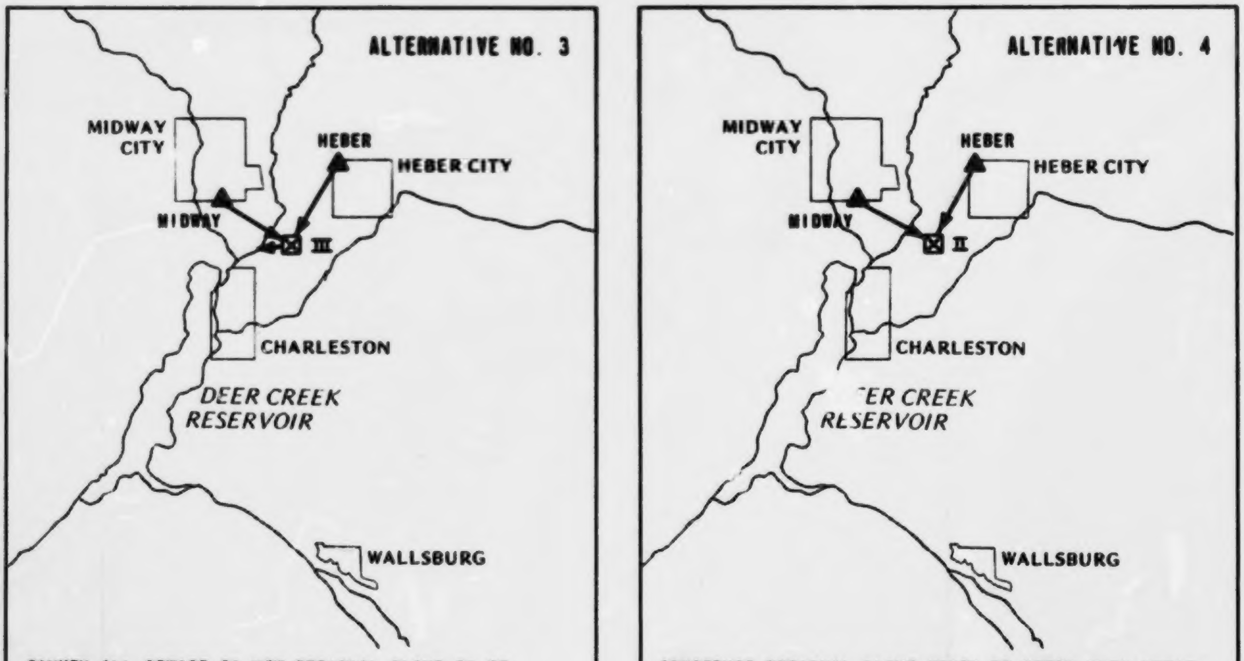
FIGURE IV-31

WASTEWATER TREATMENT ALTERNATIVES - WASATCH COUNTY


ALTERNATIVE NO. 1
MIDWAY CITY
HEBER
HEBER CITY
IV
MIDWAY
IV
CHARLESTON
DEER CREEK RESERVOIR
WALLSBURG
ALTERNATIVE NO. 2
MIDWAY CITY
HEBER
HEBER CITY
III
III
MIDWAY
CHARLESTON
DEER CREEK RESERVOIR
WALLSBURG

MODIFY EXISTING PLANTS AT PRESENT LOCATIONS. WITH TREATMENT LEVEL IV AT HEBER AND MIDWAY PLANTS. DISCHARGE POINTS AS EXISTING ON SPRING AND SNAKE CREEKS.

MODIFY EXISTING PLANTS AT PRESENT LOCATIONS WITH TREATMENT LEVEL III AT HEBER AND AT MIDWAY HEBER TO CONSTRUCT OUTFALL TO PROVO RIVER; MIDWAY TO CONTINUE DISCHARGE AT PRESENT SITE.

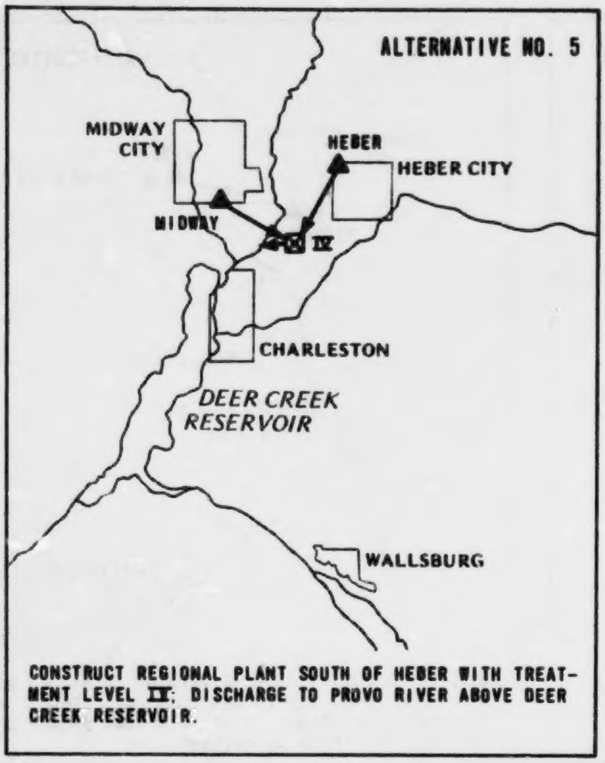

ALTERNATIVE NO. 3
MIDWAY CITY
HEBER
HEBER CITY
MIDWAY
III
CHARLESTON
DEER CREEK RESERVOIR
WALLSBURG
ALTERNATIVE NO. 4
MIDWAY CITY
HEBER
HEBER CITY
MIDWAY
II
CHARLESTON
DEER CREEK RESERVOIR
WALLSBURG

CONVEY ALL SEWAGE TO NEW REGIONAL PLANT TO BE CONSTRUCTED NEAR CHARLESTON. TREATMENT LEVEL III WITH OUTFALL TO PROVO RIVER.

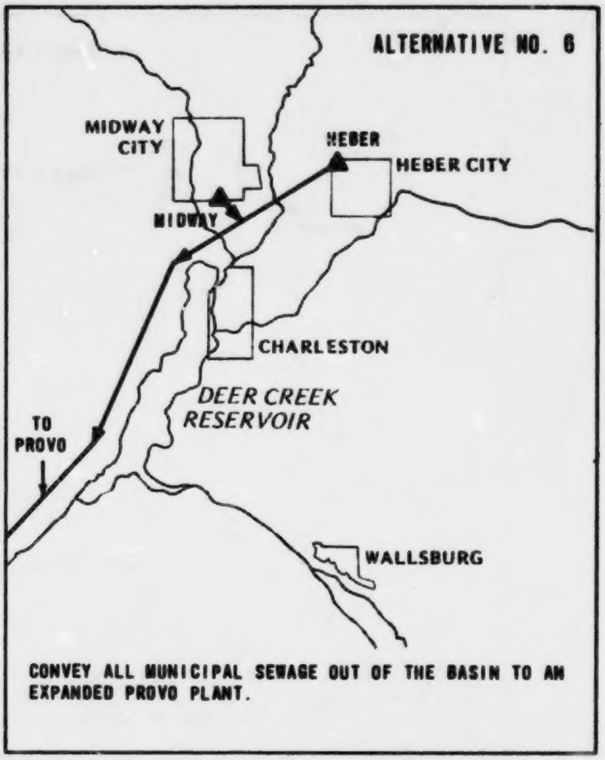
CONSTRUCT REGIONAL PLANT SOUTH OF HEBER WITH TREATMENT LEVEL II FOLLOWED BY PERCOLATION BASINS.

FIGURE IV-31 (Continued)

WASTEWATER TREATMENT ALTERNATIVES - WASATCH COUNTY


ALTERNATIVE NO. 5
MIDWAY CITY
HEBER
HEBER CITY
MIDWAY
IV
CHARLESTON
DEER CREEK RESERVOIR
WALLSBURG

CONSTRUCT REGIONAL PLANT SOUTH OF HEBER WITH TREATMENT LEVEL IV; DISCHARGE TO PROVO RIVER ABOVE DEER CREEK RESERVOIR.


ALTERNATIVE NO. 6
MIDWAY CITY
HEBER
HEBER CITY
MIDWAY
CHARLESTON
DEER CREEK RESERVOIR
TO PROVO
WALLSBURG

CONVEY ALL MUNICIPAL SEWAGE OUT OF THE BASIN TO AN EXPANDED PROVO PLANT.

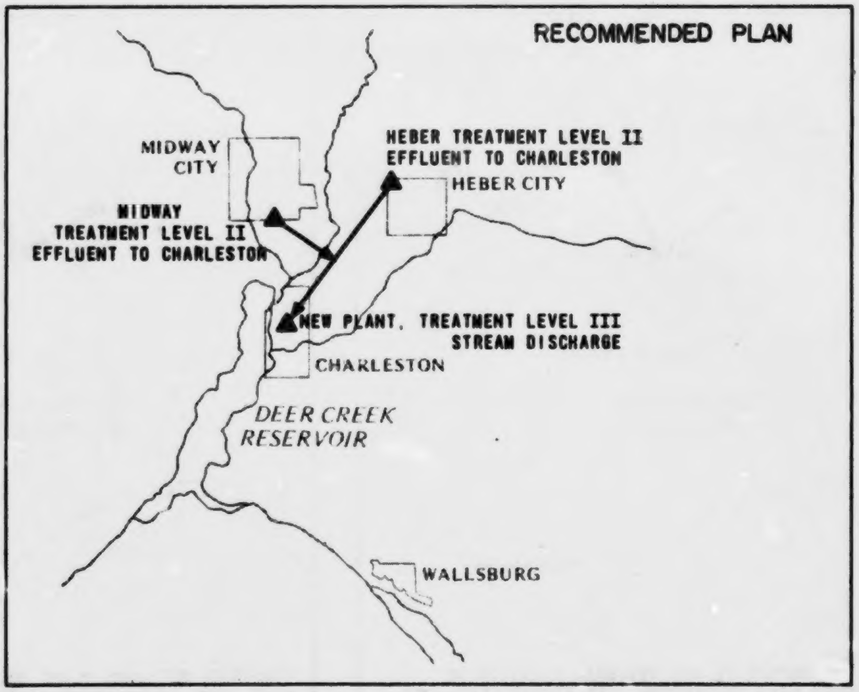

RECOMMENDED PLAN
MIDWAY CITY
HEBER TREATMENT LEVEL II EFFLUENT TO CHARLESTON
HEBER CITY
MIDWAY TREATMENT LEVEL II EFFLUENT TO CHARLESTON
NEW PLANT, TREATMENT LEVEL III STREAM DISCHARGE
CHARLESTON
DEER CREEK RESERVOIR
WALLSBURG

TABLE IV-7

COST ANALYSIS FOR WASATCH COUNTY

Categories of Alternatives		Capital Cost ($$10^6$)	Annual Operation & Maintenance Cost ($$10^6$/Yr)	Annual Cost Per Capita ($/Cap/Yr)
Level III Alternatives				
WC-2		0.85	0.12	30.30
WC-3		1.93	0.10	40.91
Level IV Alternatives				
WC-1		1.38	0.14	40.91
WC-5		2.65	0.12	54.55
Secondary Treatment with Land Disposal				
WC-4		1.59	0.06	30.30
Convey Flows to Provo with Level III Treatment				
WC-6	[a]Interceptor	4.65	0.02	50.00
	[b]WWTP	1.39	0.05	32.30
	TOTAL			82.30
Recommended Plan				
Level III		0.95	0.12	30.30
Secondary		0.00	0.07	10.61

[a] Costs totally funded by Hever Valley populace.

[b] Heber Valley's proportionate share of wastewater treatment at Provo.

FIGURE IV-32

BOD WASTE LOADS - WASATCH COUNTY

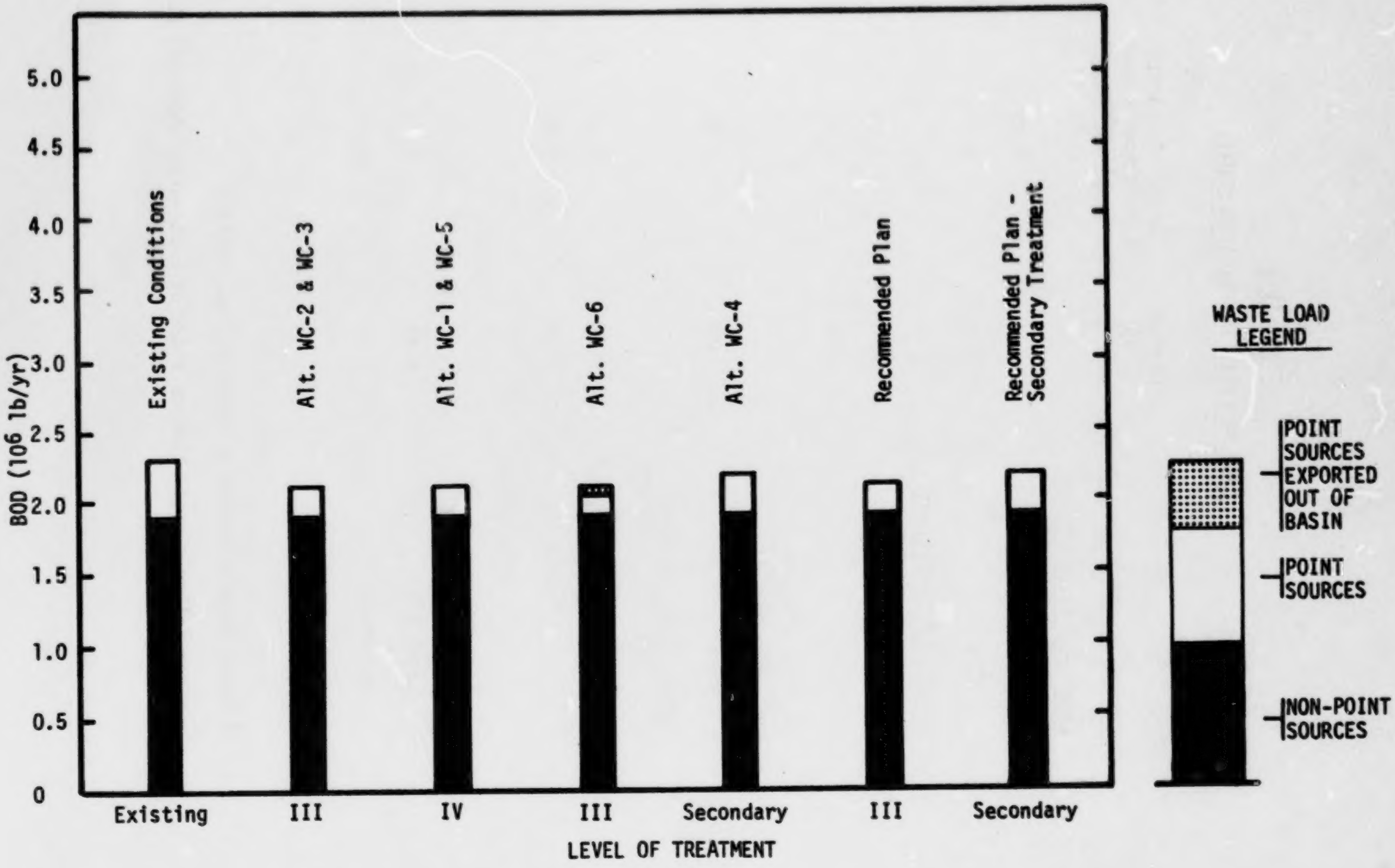


FIGURE IV-33

TDS WASTE LOADS - WASATCH COUNTY

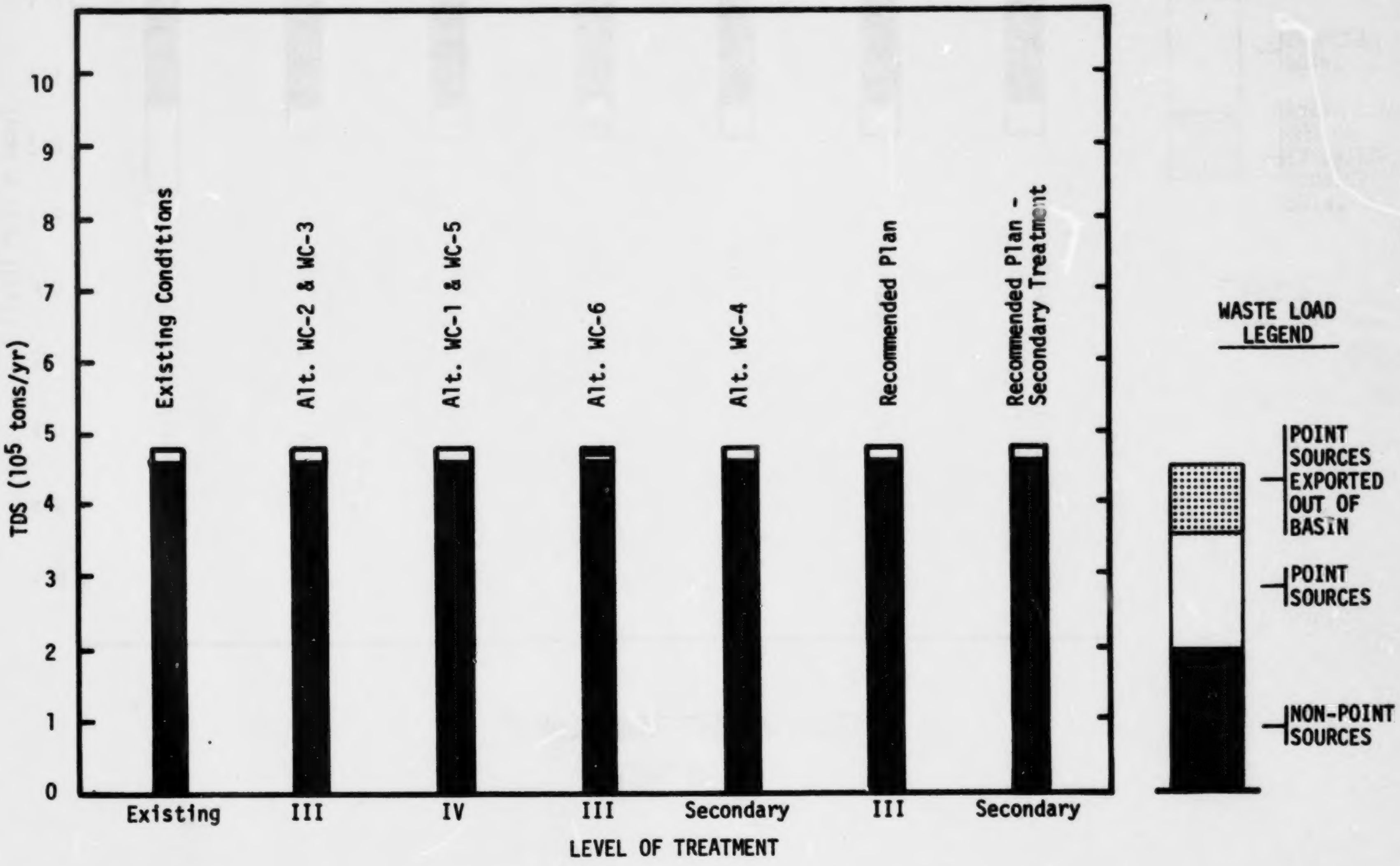


FIGURE IV-34

TN WASTE LOADS - WASATCH COUNTY

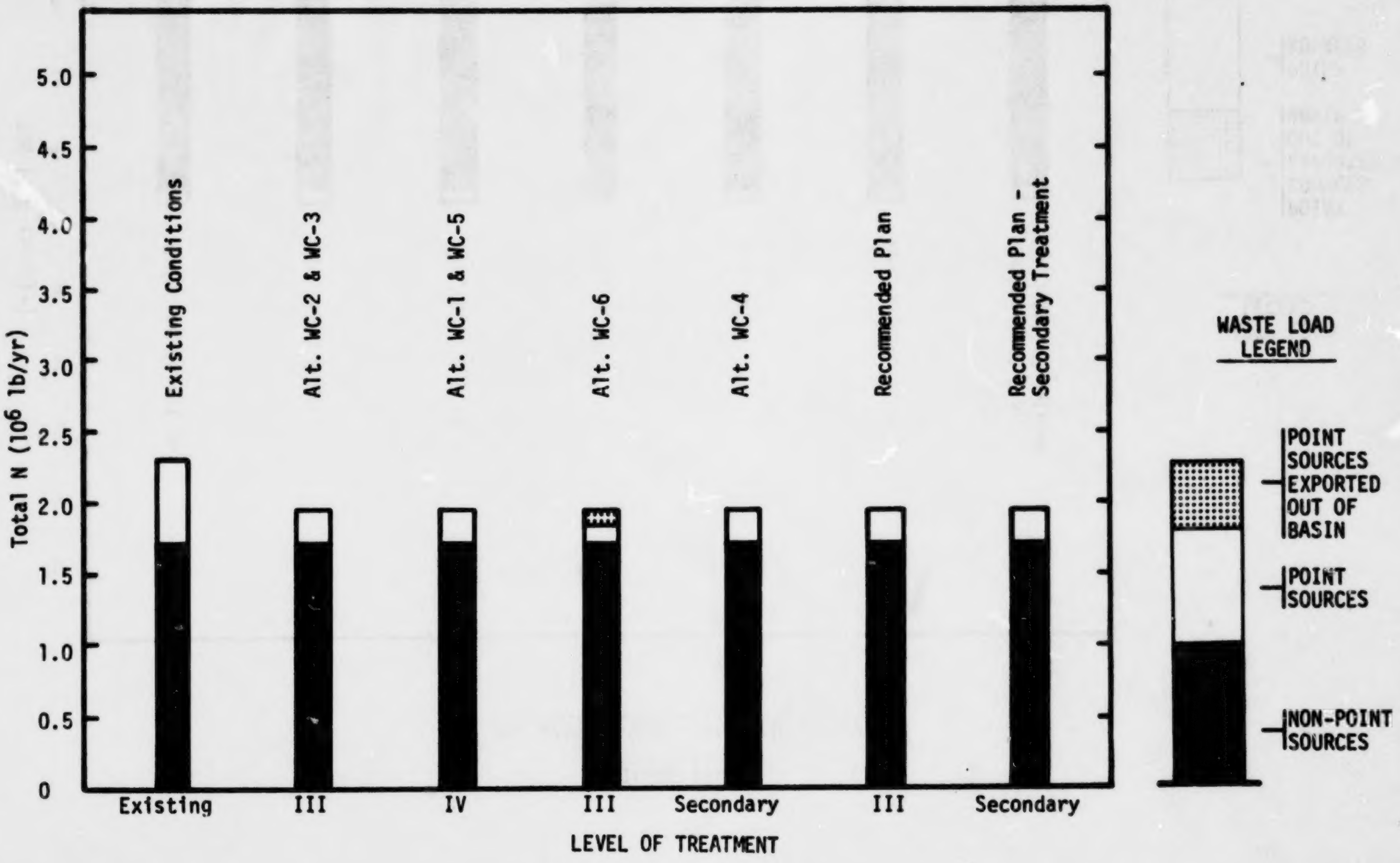


FIGURE IV-35

PO$_4$ WASTE LOADS - WASATCH COUNTY

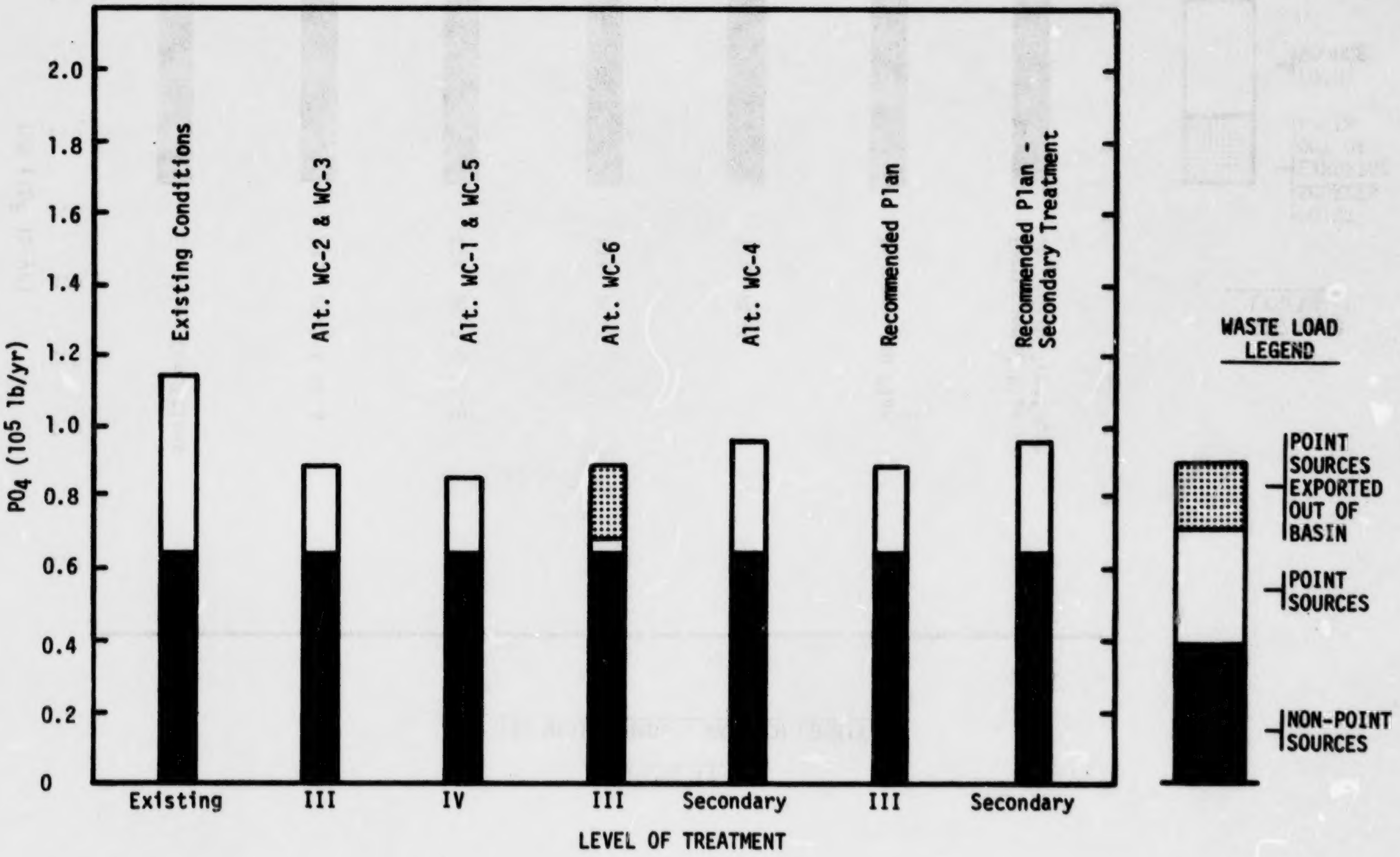
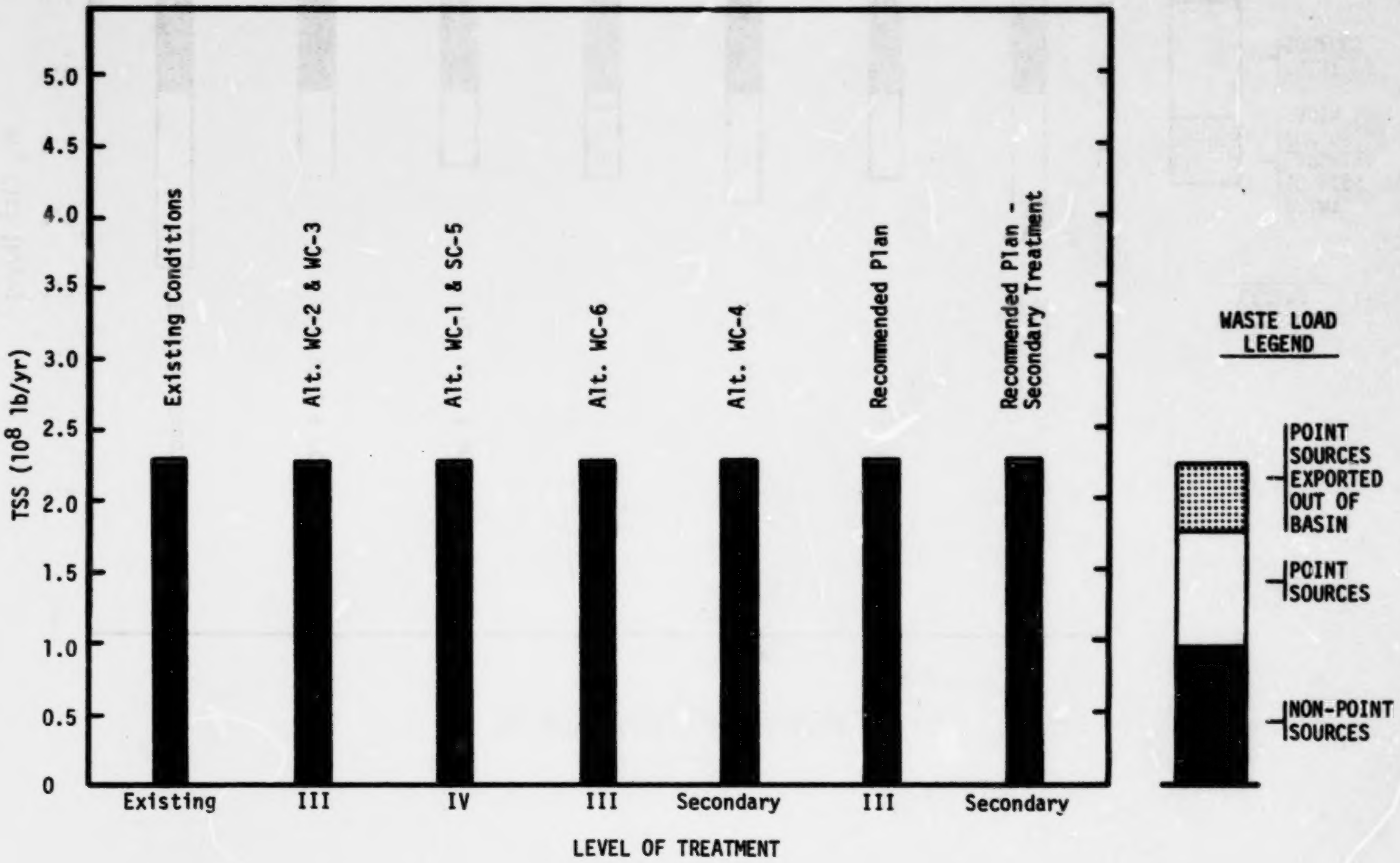


FIGURE IV-36

TSS WASTE LOADS - WASATCH COUNTY



discharged has a significant impact on the surface waters used for water supplies. That is, all alternatives except WC-6 require discharges in or above Deer Creek Reservoir. Because the Reservoir is a source of raw water for Provo, these alternatives may have a deleterious impact on that use.

Aquatic Impacts

The aquatic impacts of the alternative wastewater treatment schemes are extremely difficult to assess for Wasatch County because of the almost total lack of water quality data in this area. From what little information is available, it can be concluded that Alternative WC-2 with its discharge of Heber effluent to the Provo River may enhance the aquatic habitat of Spring Creek, but at the expense of the Provo River. Additionally, the closer the discharge of wastewaters to Deer Creek Reservoir, the higher the potential for nutrient enrichment of the Reservoir.

Alternative WC-4 contains a recommendation for secondary treatment and land disposal. The groundwater table in Wasatch County is extremely high and waste loads imposed on the land for assimilation may adversely affect the quality of the groundwater.

Summary

The following observations can be made regarding the costs, waste loads, and aquatic impacts associated with alternative wastewater treatment systems for Wasatch County:

- The recommended plan is the most economical alternative.
- Alternatives WC-2 and WC-4 have costs equivalent to the recommended plan but for vastly different configurations.
- The recommended plan with secondary treatment is one-third the cost of the same plan with Level III treatment.
- Because of substantial non-point waste loads, relatively small differences in total waste loads for any single parameter occur between alternatives.
- Alternative WC-4 may adversely affect groundwater quality.
- Alternatives WC-2, WC-3, WC-5, and the recommended plan may improve the aquatic habitats of Spring Creek but at the expense of the Provo River.

LEGAL IMPLICATIONS

A significant problem associated with the implementation of any wastewater treatment alternative in the Study Area is the impact on existing water rights. Existing water law in the Study Area can be summed up in the following:

- Utah water law is founded on the Colorado Doctrine of prior appropriation; i.e., "First in time - first in right."
- Water law in Utah is an adjudicatory process rather than a statuatory process. Thus, the fundamentals of prior appropriation are derived from legal actions, not from legislative actions.
- Water rights in the Study Area are highly complex and not clearly definable.

Given these fundamentals, it is impossible to pre-judge the nature of water rights problems which could develop from implementation of any wastewater treatment alternative. This can be accomplished only through judicial processes. Thus, to define the potential legal impacts, several different treatment scenarios are offered together with the resulting possible water rights implications.

No Change Scenario

This scenario includes those alternative treatment schemes whereby some or all existing facilities are maintained and simply upgraded and expanded to accommodate additional wastewater flow and/or treatment. Also, discharges are at existing treatment plants. In this situation, no water rights problems are expected to develop from discharge locations.

Regionalization Scenario

This scenario includes those wastewater treatment alternatives which require consolidation of two or more existing treatment facilities. If an appropriator downstream of an abandoned discharge is adversely affected by consolidation, he may enter into litigation to halt plan implementation. The jurisdiction or authority embracing the regionalized area may take any of the following recourses:

- enter into litigation to implement the project
- purchase that portion of the appropriator's water right which is affected
- transfer another water right to satisfy the appropriator's need
- implement consolidation and pump back that portion of the appropriator's water right which is affected
- do not implement the plan.

Transfer of Point of Discharge Scenario

Changes in effluent discharge locations are addressed in this scenario. The impact on downstream water users is similar to that in the previous scenario. A downstream appropriator may enter into litigation because his water right would be committed elsewhere. The jurisdiction or authority may exercise any of the following options:

- enter into litigation to implement project
- purchase the water rights affected by the transfer
- substitute the transferred water with another water right
- do not implement the project.

There are also water quality implications in an effluent transfer scenario. In a 1954 decision, the 2nd District Court of Utah (Salt Lake City v. Boundary Springs Water Users Association, 2 Utah 2d 141, 144, 270 p. 2d 453, (1954)) stipulated, "The owner of a water right has a vested right to the quality as well as the quantity which he has benefically used." Thus, water users downstream of the new discharge location have legal recourse if they feel their water rights have been preempted through quality degradation.

Recycle-Reuse and Land Disposal Scenarios

Recycle-reuse and land disposal are two alternatives not precisely addressed in the Plan, but that are being more seriously considered as further technological advances are made. As such, these alternatives could have serious impacts on water rights. Implementation of either of these options may interfere with an appropriator's surface or groundwater rights and lead to litigation. Actions by the appropriate jurisdiction or authority may include:

- enter into litigation
- purchase that portion of the appropriator's water right affected by the alternative
- supply the appropriator with another water right
- do not implement project.

CHAPTER V

LAND RESOURCE IMPACTS

OVERVIEW

Land resource impacts resulting from implementation of any Plan alternative wastewater management scheme can be divided into impacts on:

- land uses
- financial and economic resources
- terrestrial ecosystem
- historical and archaeological sites
- social systems.

Within each of these categories, environmental impacts may be termed:

- beneficial or adverse
- short term or long term
- reversible or irreversible
- direct or indirect.

Beneficial or adverse impacts are often easily definable (i.e., degrades water quality vs doesn't degrade water quality) yet subjectiveness still exists within this impact characterization. What may be a beneficial impact to an industrialist may be an adverse impact to a farmer. Short term vs long term impacts are also clearly definable. Extending sewage outfall across a marshland may cause short term impacts on the sensitive ecosystem while continual discharge of sewage at the edge of the marsh may create long term problems.

Reversible and irreversible impacts are sometimes harder to define. Certainly building a sewage treatment plant or interceptor produces certain irreversible impacts at least over the life of the project. Reversible impacts may include the commitment to a certain treatment level with the option to go to land disposal or some other treatment level in the future.

Direct or indirect impacts can be identified in terms of land use. Destruction of an historical site from construction of an interceptor is a direct impact. If the historical site is destroyed from induced growth, that is an indirect impact. Except for land committed to construction of wastewater management systems, most land use impacts can be viewed as indirect.

LAND USE IMPACTS

All of the treatment alternatives discussed in Chapter III were based on a common land use plan also presented in Chapter III. Thus, it is difficult to identify differences in land use impacts on a basin basis resulting from implementation of alternative treatment plans. This is not to say that the Plan does not have regional land use impacts or that any treatment alternatives does not have more localized impacts. Because of this situation, land use impacts are presented in terms of direct impacts (environmental responses to alternative implementation) and indirect impacts (environmental responses to effects caused by alternative implementation).

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Indirect Impacts

Indirect land use impacts are best evaluated in terms of the land use policies articulated for the Study Area. The following is a brief summary of land use policies contained in available county comprehensive plans.

The Davis County Master Plan (October 1970) contains basic land use policies addressing agriculture and urban sprawl:

1. Agricultural lands, not needed for urban use .... should be maintained in parcels large enough for efficient crop production.
2. Urban development should be confined to areas within the existing 16 municipalities and which have well drained to moderately drained soils and slopes not exceeding 20 percent. Urbanization of unincorporated areas is not recommended.
3. Urban sprawl, the fragmentation of agricultural land into small parcels and leap-frog residential development, is the number one enemy of agriculture.
4. The rural flavor of the County should be preserved.

The 1985 Salt Lake Valley Plan (1965) contains the following basic land use policies for developing areas of Salt Lake County:

1. Agriculture is an important industry in the Valley and should be protected and maintained where the following circumstances exist:
    a. where the best soil is found and water is available
    b. when urbanization would be detrimental to the County's physical and economic well being.
2. Where feasible, non-agricultural land should be used for urban expansion.

The Salt Lake Comprehensive Plan made other statements which represent land use recommendations:

1. Adequate land exists within the then current urbanizing area to accommodate projected 1985 population growth, without further encroachment into prime agricultural areas.
2. The prime agricultural belt lies south and southwest of the urbanizing area. It should be retained as agricultural use.

Utah County has recently, in 1975, updated the land use element of their Master Plan. Although policies are not specifically outlined, the basic plan objectives and recommendations identify land use proposals. The basic elements of these proposals include:

1. Urban development should occur in the following sequence:
    a. First, in municipalities
    b. Second, in areas surrounding municipalities on land best suited for urban purposes
    c. Third, in existing unincorporated urban communities within those areas served by water systems
    d. Fourth, in unincorporated communities that are not served by water systems, but in which a significant number of non-farm homes have already been constructed; and,
    e. Fifth, a limited number of bona fide new towns in the unincorporated area of the County.

2. Indiscriminate leap-frogging of subdivision and non-farm development is discouraged.
3. Preserve agricultural land by encouraging only bona fide agricultural uses and certain other ancillary uses to be constructed and maintained on lands that are most appropriately suited for agricultural use.
4. Urban centers are to be separated from each other by a belt of cropland, grazing land, or other open space.
5. Priorities for use of Provo Canyon are:
    a. Watershed
    b. Recreation
    c. Transportation
    d. Agriculture
    e. Commerce
    f. Industry (extractive)
    g. Housing
6. The Provo Canyon land use goal is: Encourage the use of land in a way that will (1) protect the health and safety of nearby residents, (2) preserve the unique and unusual natural features for future generations, and (3) promote the desires and economic needs of present property owners.

The Wasatch County Comprehensive Plan (1974) includes the following policies related to land use:

1. Development within the mountains should be clustered in a manner that will preserve scenic values, conform to health and sanitation standards, preserve and protect the flora and wildlife of the surrounding area, and minimize soil erosion.
2. The Wasatch County Council of Governments should adopt and implement the type of urban form in Heber Valley that is characterized by compactly built communities surrounded by green belts. In other words, the municipalities and the county should declare that future urban development should take place within cities and towns where essential services are already available, or where they can be provided and maintained at the least possible cost.
3. The Council of Governments should also adopt and implement the type or urban form in the mountainous areas that is characterized by compactly built clusters of vacation-type houses surrounded by large areas of open range and forest lands.

In total, these land use policies encourage protection of agricultural land, urban centers separated by open space, and development of existing urban areas. The policies discourage indiscriminate leap-frogging of residential development, fragmentation of agricultural uses, and urban sprawl. There seems to be ample evidence that existing land use has not been regulated in conformance with these policies. Thus, without stricter land use management, urban sprawl and pocket development can be expected to continue.

Because the wastewater treatment alternatives contained in the Plan were based on a specific land use plan (see Chapter III), the alternatives can be thought of as inducing or accommodating that specific level of development delineated by the land use plan. The level of information contained in the land use plan is not sufficiently detailed to permit any assessment of basin-wide impacts from induced growth; however, the location of interceptor lines and available treatment capacity of a service area certainly will influence the location of development within the Study Area. Without strict land use controls, interceptors constructed in previously unsewered areas can influence strip development along the interceptor, resulting in increased costs for vacant or agricultural lands because of land speculation, scattered urban land development, and/or leap-frog residential growth and urban sprawl. Such development patterns are likely to create adverse impacts including the permanent loss of agricultural lands, increased demands for all types of urban services (schools, parks, roads, utilities, police and fire protection, etc.), and the escalation of the decline of the local agricultural economy from inflated land values and taxes. Sprawl development can increase driving and commuting costs, air pollution, and increased stormwater runoff and associated pollutants resulting in both a greater amount and lower quality of water in local streams. Under this type of development pattern, natural woodlands and wildlife habitats may be eliminated or substantially altered due to the intrusion of housing projects or other urban uses. Besides endangering wildlife, considerable recreation and tourist values may be lost or limited. Additionally, visual identity is frequently lost, that is, it becomes increasingly more difficult to visually identify one community from its neighbor if boundaries are mutually shared and a rural area between the two does not exist.

All wastewater treatment alternatives which include major interceptors are presented in Table V-1 together with the potential impacts resulting from the types of development which may occur without strict land use management. Upon review of these alternatives in Davis and Utah Counties, it can be concluded that regionalization in these counties could induce development of agricultural land leading to adverse impacts such as the reduction of agricultural land, increased transportation-related problems, increased runoff, and loss of wildlife habitat. Regionalization in Salt Lake County will probably have minimum adverse impact because treatment alternatives considered already cross developed land or are in areas where development will probably occur regardless of interceptor location. Consolidation in Wasatch County has potential adverse impacts in terms of lost agricultural land, increased runoff, and loss of wildlife habitat. In addition, the proposed alternatives which include a major interceptor through Provo Canyon will increase the rate of development and density of development in the area, creating potential adverse impacts such as loss of wildlife habitat and vegetative cover, erosion due to increased runoff, aesthetic degradation, and demand for other services.

Direct Impacts

Direct land use impacts include those localized impacts from treatment plant construction and operation. These impacts include noise from

TABLE V-1

ALTERNATIVES INCLUDING MAJOR INTERCEPTOR CONSTRUCTION AND POSSIBLE LAND USE IMPACTS

Alternative	Area of Influence	Comments
DC-5	Agricultural land between Central and North Davis STP	Potential for strip development and adverse land use impacts are high.
DC-6	Same as DC-5	Same As DC-5.
DC-7	Agricultural land between South Davis South and South Davis North STP	Potential for strip development and adverse land use impacts are high.
DC-8	Same as DC-7	Same as DC-7.
DC-9	Agricultural land between South Davis South and Central Davis STP	Potential for strip development and adverse land use impacts are high. Also would adversely impact Farmington Bird Refuge.
DC-10	Agricultural and industrial land between South Davis South and Salt Lake City STP	Potential for industrial development high but adverse land use impacts minimal because some of the area already has industrial development.
DC-11	Same as DC-10	Same as DC-10.
DC-12	Agricultural and industrial land between South Davis North and Salt Lake City STP	Between South Davis North and South Davis South STP impacts same as DC-7; between South Davis South and Salt Lake City STP impact same as DC-10.
DC-13	Same as DC-12	Same as DC-12.
Davis County Recommended Plan	Same as DC-7	Same as DC-7.

TABLE V-1 (Continued)

ALTERNATIVES INCLUDING MAJOR INTERCEPTOR CONSTRUCTION AND POSSIBLE LAND USE IMPACTS

Alternative	Area of Influence	Comments
SLC-3	Industrial land in area of Granger-Hunter, South Salt Lake, Salt Lake SSD #1, Cottonwood, and Murray STP	Impacts minimal.
	Agricultural and residential land between Sandy and Tri-Community	Potential for urban development west of facilities high but adverse impacts low because infilling will probably occur in area without interceptor.
SLC-4	Same as SLC-3	Same as SLC-3.
SLC-5	Agricultural and residential land between Sandy and Tri-Community STP	Same as SLC 3 impacts in this area.
	Industrial land in area of Granger-Hunter, South Salt Lake SSD-1, Cottonwood, and Murray STP	Same as SLC-3 impacts in this area.
SLC-6	Same as SLC-5	Same as SLC-5.
	Agricultural lands north of Tri-Community	Will influence residential development in this area but development will most likely occur without interceptor.
SLC-7	Same as SLC-6	Same as SLC-6.
	Industrial strip between South Salt Lake and Salt Lake City STP	Will encourage further industrial development but will have minimal adverse land use impacts.
SLC-8	Same as SLC-7	Same as SLC-7.
SLC-9	Same as SLC-5	Same as SLC-5.

TABLE V-1 (Continued)

ALTERNATIVES INCLUDING MAJOR INTERCEPTOR CONSTRUCTION AND POSSIBLE LAND USE IMPACTS

Alternative	Area of Influence	Comments
SLC-10	Same as SLC-6	Same as SLC-6.
SLC-11	Same as SLC-7	Same as SLC-7.
SLC-12	Same as SLC-6	Same as SLC-6.
SLC Recommended Plan	Same as SLC-10	Same as SLC-10.
NUC-5	Agricultural land along northern edge of Utah Lake	Will encourage development outward from existing communities; significant impact on agricultural lands.
NUC-6	Same as NUC-5	Same as NUC-5.
NUC-7	Same as NUC-5	Same as NUC-5.
NUC-8	Agricultural land along northern edge of Utah Lake	Same as NUC-5.
	Industrial land (Geneva Steel) between Pleasant Grove & Orem	Land is already in heavy industry - no significant impacts.
NUC-9	Same as NUC-8	Same as NUC-8.
NUC Recommended Plan	Same as NUC-5	Same as NUC-5.
CUC-3	Agricultural land between Salem and Payson	Could encourage development of agricultural land - significant impact.

TABLE V-1 (Continued)

ALTERNATIVES INCLUDING MAJOR INTERCEPTOR CONSTRUCTION AND POSSIBLE LAND USE IMPACTS

Alternative	Area of Influence	Comments
CUC-4	Same as CUC-3	Same as CUC-3.
CUC-5	Agricultural land north of Spanish Fork to Provo	Could encourage development of agricultural land - significant impact.
CUC-6	Same as CUC-5	Same as CUC-5.
CUC-7	Same as CUC-5	Same as CUC-5.
CUC-9	Agricultural land between Springville and Provo	Could encourage development of agricultural land - significant impact.
CUC-10	Agricultural land east of Utah Lake	Could encourage development of agricultural land - significant impact.
CUC-11	Same as CUC-10	Same as CUC-10.
CUC-12	Same as CUC-10	Same as CUC-10.
CUC Recommended Plan	Same as CUC-10	Same as CUC-10.
WC-3	Agricultural land in Heber Valley	Could encourage development of agricultural land - significant impact.
WC-4	Same as WC-3	Same as WC-3.
WC-5	Same as WC-3	Same as WC-3.

TABLE V-1 (Continued)

ALTERNATIVES INCLUDING MAJOR INTERCEPTOR CONSTRUCTION AND POSSIBLE LAND USE IMPACTS

Alternative	Area of Influence	Comments
WC-6	Agricultural land in Heber Valley	Could encourage development of agricultural land - significant impact.
	Provo Canyon	Major impact in Canyon from development.
WC Recommended Plan	Same as WC-3	Same as WC-3.

construction equipment and operational equipment, dust, odors, aesthetics, and the psychological impact of living near a treatment facility. Each existing facility was assessed in terms of existing adjacent land uses and the probable increased encroachment due to future land use.

Considering the above context, existing and probable future adjacent land use impacts were evaluated in terms of the proximity of the treatment plant to residential and non-residential (industrial and commercial) land uses. The following criteria were established:

- Severe (S) - 0 to ¼ mile separation. Significant potential for construction and operation related impacts. Aesthetic, odor, and psychological impact is extreme.
- Severe to Moderate (S/M) - ¼ to ½ mile separation. Facility is still close enough to existing residential land use to create significant adverse impact and potential exists for increased encroachment in the future.
- Moderate to Negligible (M/N) - ½ to 1 mile separation. Sufficient vacant land exists between the facility and surrounding residential land to buffer adverse impacts or surrounding land use is compatible, non-residential use. Additionally, there is some room for expansion of facility and/or increased development without serious encroachment.
- Negligible (N) - 1 or more miles separation. Little or no existing or future adverse impact expected.

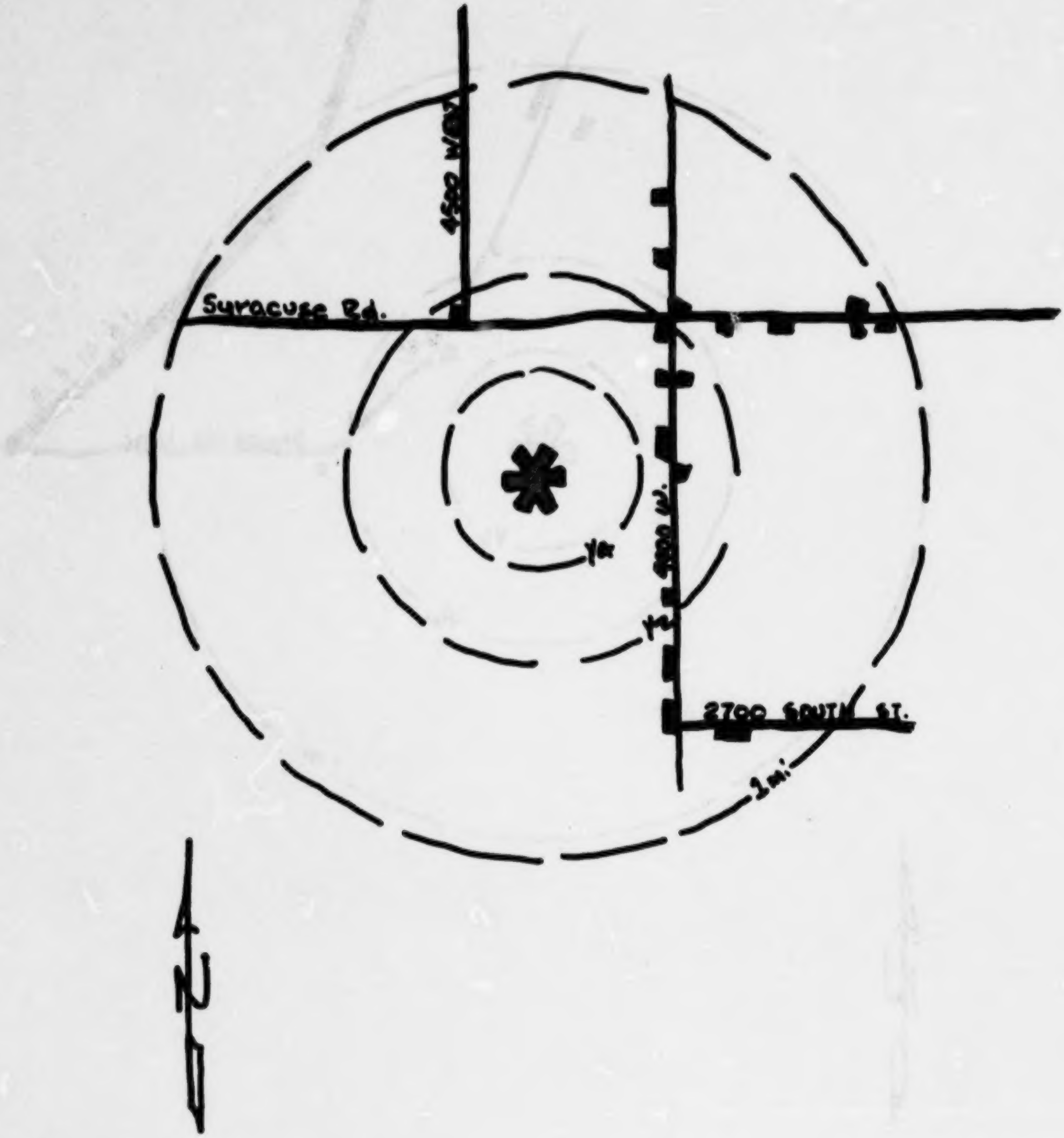
An asterisk (*) is used to denote emphasis. For example, M*/N indicates that the impact is more likely to be "moderate" than "negligible." This was used to indicate slight increases in impact at treatment plants when they are specified as regional facilities accepting wastes from abandoned facilities.

Adjacent land use impacts for the various treatment alternatives based on the above criteria are presented in Tables V-2 through V-6 and discussed in the following.

Davis County

The existing adjacent land uses for Davis County wastewater treatment plants are illustrated in Figures V-1 to V-4 and impacts are presented in Table V-2. All of the Davis County alternatives will create or expand adjacent land use conflicts. However, overall the problems do not appear to be critical. Residential development, although nearby in some instances, is sparsely developed, rural large lot homes, and farms. As long as these residential densities do not become more intense, any of the alternates would appear to be acceptable based on adjacent land use conflict analysis.

The North Davis and Central Davis facilities will have severe to moderate adverse impacts under all Davis County alternatives except DC-5 and DC-6 where Central Davis is abandoned. There is some residential development within ¼ to ½ mile of these facilities and potential exists for further development in the future. There is little or no non-residential (industrial or commercial) development close to these plants.


4500 West
Syracuse Rd.
3000 W.
2700 South St.
1/4
1/2
1 mi.
N

✱ Treatment Plant
■ Residential
■ Non-residential
☐ Vacant

Figure V-1
ADJACENT LAND USES

NORTH DAVIS

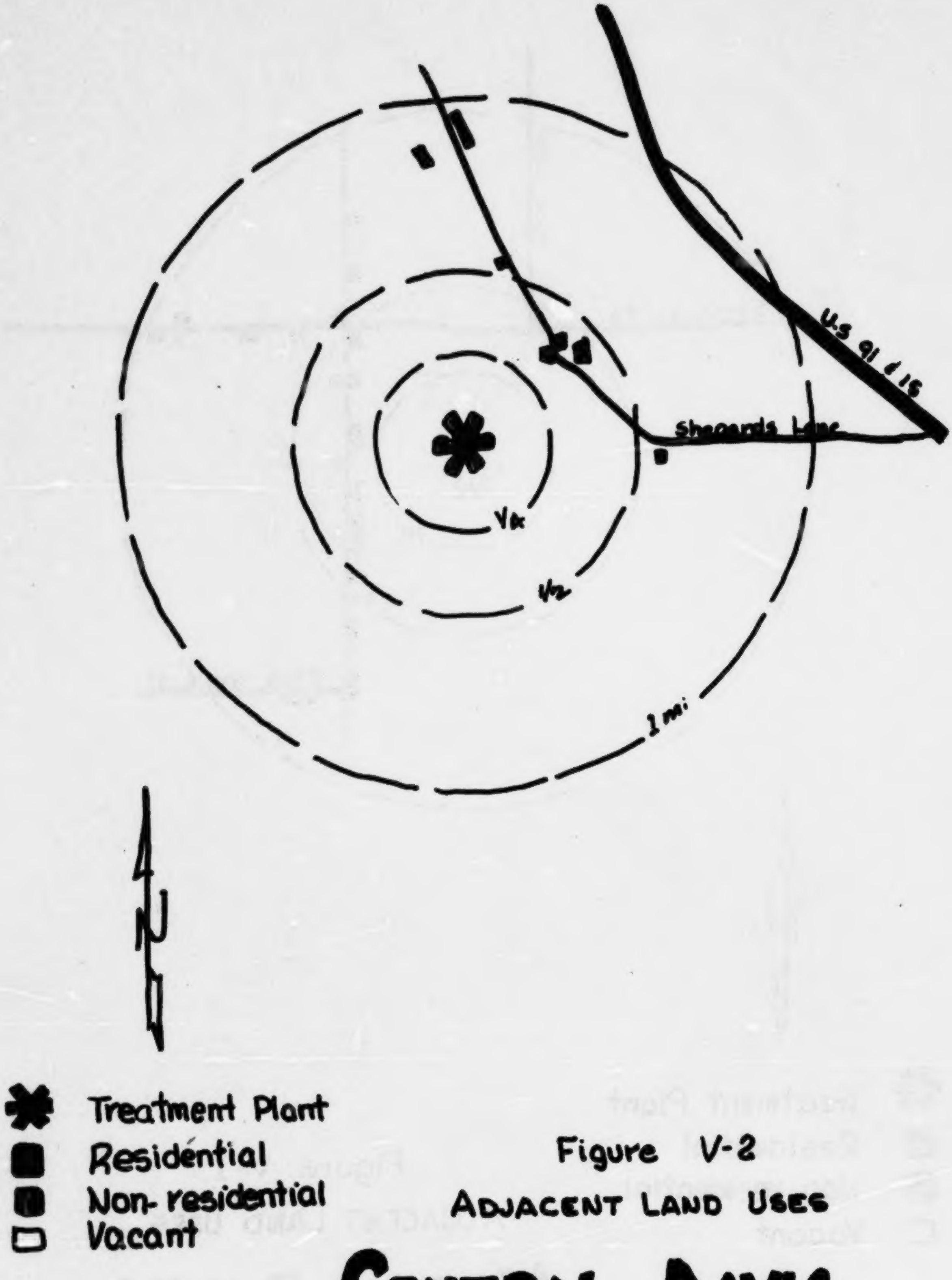
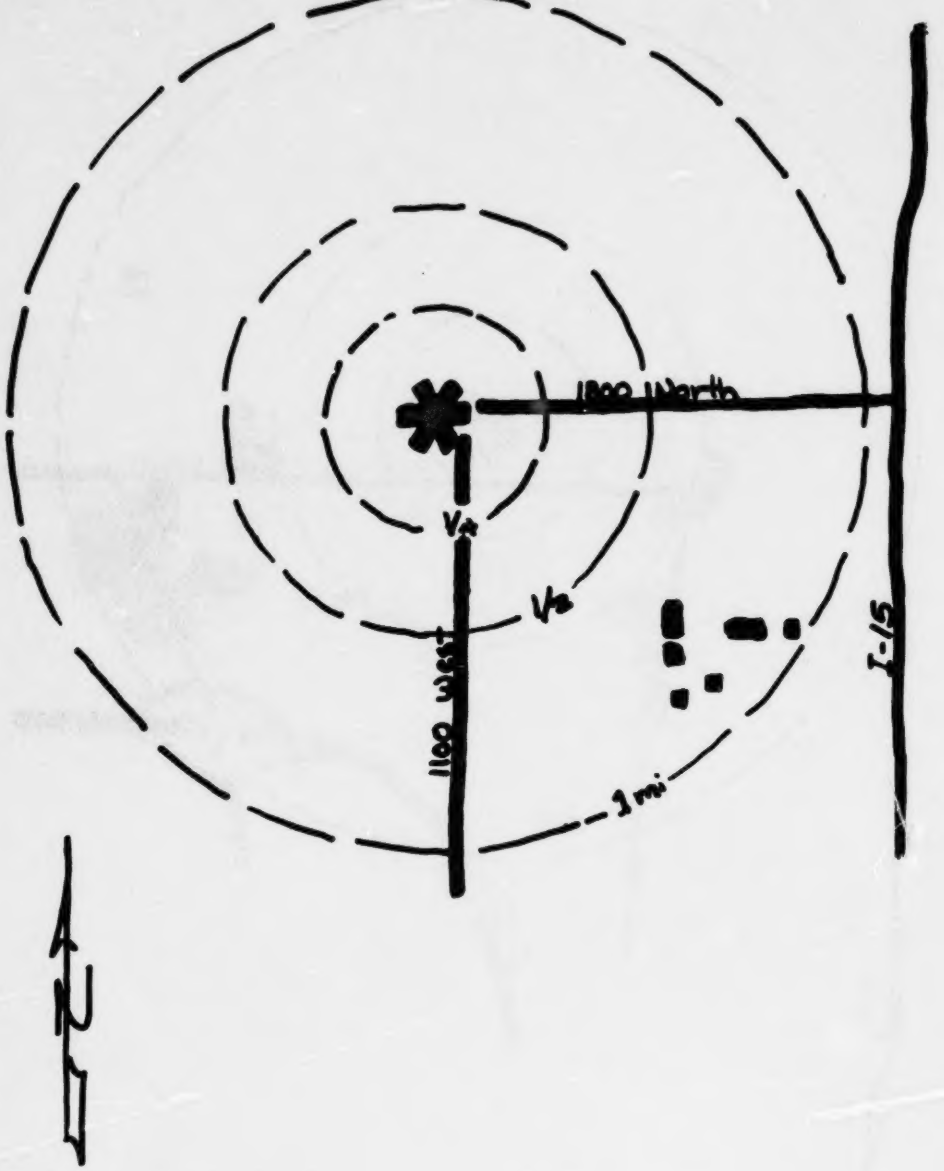

U.S 91 & 15
Shepards Lane
1/4
1/2
1 mi
N
✱ Treatment Plant
■ Residential
▨ Non-residential
□ Vacant

Figure V-2
ADJACENT LAND USES

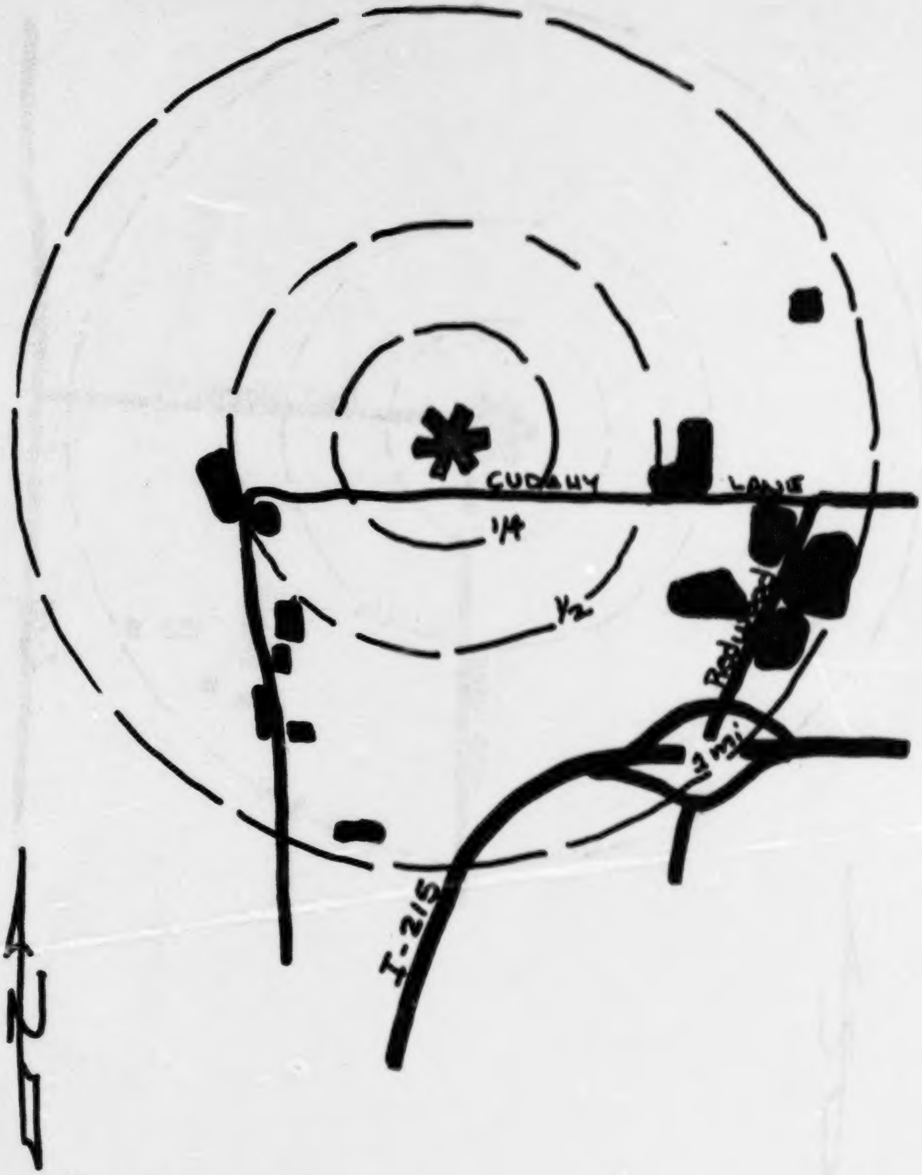
CENTRAL DAVIS


1800 North
1/4
1/2
1 mi
1100 West
I-15
N

✱ Treatment Plant
■ Residential
■ Non-residential
☐ Vacant

Figure V-3
ADJACENT LAND USES

SOUTH DAVIS NORTH


CUDAHY
LANE
1/4
1/2
1 mi
Redwood Road
I-215
N

✱ Treatment Plant
▨ Residential
■ Non-residential
☐ Vacant

Figure V-4
ADJACENT LAND USES

TABLE V-2

ADJACENT LAND USE IMPACTS DAVIS COUNTY MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES

Alternate	North Davis	Central Davis	South Davis North	South Davis South
DC-1	S/M	S/M	M/N	M/N
DC-2	S/M	S/M	M/N	M/N
DC-3	S/M	S/M	M/N	M/N
DC-4	S/M	S/M	M/N	M/N
DC-5	S*/M	-	M/N	M/N
DC-6	S*/M	-	M/N	M/N
DC-7	S/M	S/M	M*/N	-
DC-8	S/M	S/M	M*/N	-
DC-9	S/M	S*/M	-	-
DC-10	S/M	S/M	M/N	-
DC-11	S/M	S/M	M/N	-
DC-12	S/M	S/M	-	-
DC-13	S/M	S/M	-	-
DC Recommended Plan	S/M	S/M	M*/N	-

Key:

S - Severe Adverse Impact
S/M - Severe to Moderate Impact
M/N - Moderate to Negligible Impact
N - Negligible Impact
* - Emphasis towards one End of Scale
- - Abandoned Facility
(see text for further discussion of criteria)

Adverse adjacent land use impacts at South Davis North and South Davis South are judged moderate to negligible. There is no development within ½ mile of either facility and little development between ½ mile and one mile. The South Davis South facility has some non-residential development within ½ mile to one mile of the plant. If this land could be managed to promote only non-residential land use in the future, this could act as a buffer, hence become a beneficial impact.

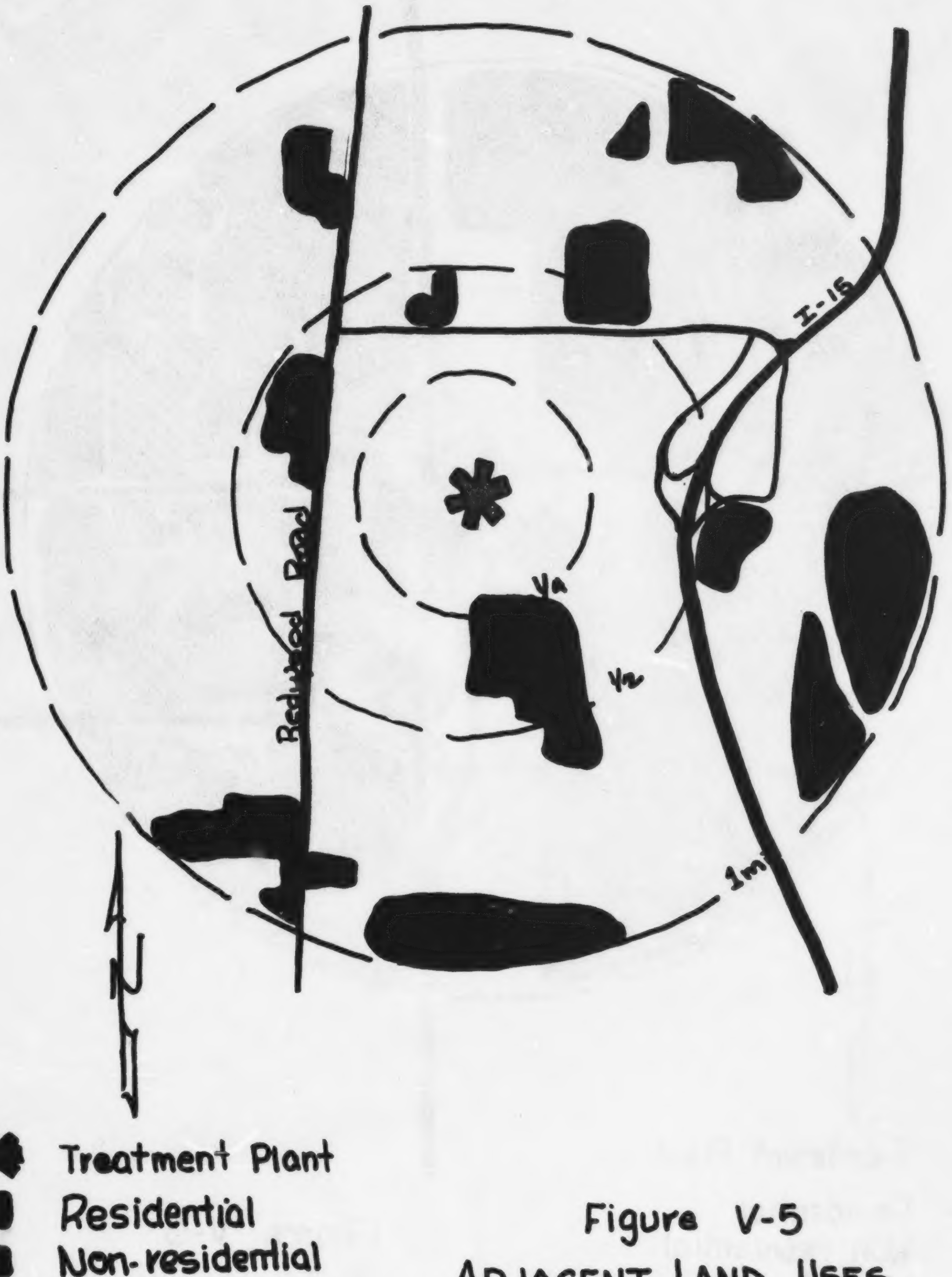
Salt Lake County

Adjacent land uses for Salt Lake County wastewater treatment facilities are illustrated in Figures V-5 to V-12. The Salt Lake City, South Salt Lake, and Salt Lake Suburban Sanitation District No. 1 plants have little or no residential development within ½ mile of the facility site. Industrial and other non-residential land uses occupy large sections of the adjacent land, thus expansion and upgrading of these facilities will probably create moderate to negligible adverse impacts on adjacent land uses. Residential land use has encroached within ½ mile of the Cottonwood, Tri-Community, and Sandy facilities. Scattered non-residential land uses exist within ½ mile of the Sandy and Cottonwood facilities. Potential adverse impacts on adjacent land uses of these three facilities are judged severe to moderate. Adverse impacts on land uses adjacent to the Granger-Hunter and Murray wastewater treatment plants are severe because of significant residential development within ¼ mile of these facilities.

Adjacent land use impacts for alternative wastewater management strategies in Salt Lake County are presented in Table V-3. From an adjacent land use impact basis, treatment alternatives SLC-7, SLC-8, and SLC-11 manifest the fewest adverse impacts. These three alternatives include the abandonment of all facilities except the Salt Lake City plant. This plant is further isolated from residential development than any of the others. The nearest residential development is about 3/4 mile from the plant site. A tank farm is nearby but makes a good neighbor. There is adequate land available in the area for expansion, or to be left vacant as a space buffer between the treatment plant and other possible urban uses.

Alternates SLC-6, SLC-10, and SLC-12 represent another group which would have fewer problems than most alternates in Salt Lake County. However, this group relies on continued use and expansion of the Salt Lake Suburban No. 1 facility which unfortunately has some residential development about ½ mile from the plant site. In addition, substantial industrial park development exists within one mile of the plant site. The condition is not severe, but could create problems if the plant is expanded.

The uranium tailings located at the Suburban Sanitation District No. 1 treatment facility have a potential adverse impact because of the potential for conveyance of harmful radioactive particles and radioactive pollution of surrounding surface and groundwater. Uncontaminated land exists for some expansion of the facility, but if the facility becomes a major regional treatment plant, as is the case in the alternatives above, additional land may have to be purchased or the uranium tailings moved. The Energy Research and Development Administration is presently funding a study to determine the impacts associated with the tailings and, if need be, the best method of removing and disposing of them.


Redwood Road
I-15
1/4
1/2
1mi
N

✱ Treatment Plant
■ Residential
■ Non-residential
▢ Vacant

Figure V-5
ADJACENT LAND USES
SALT LAKE CITY

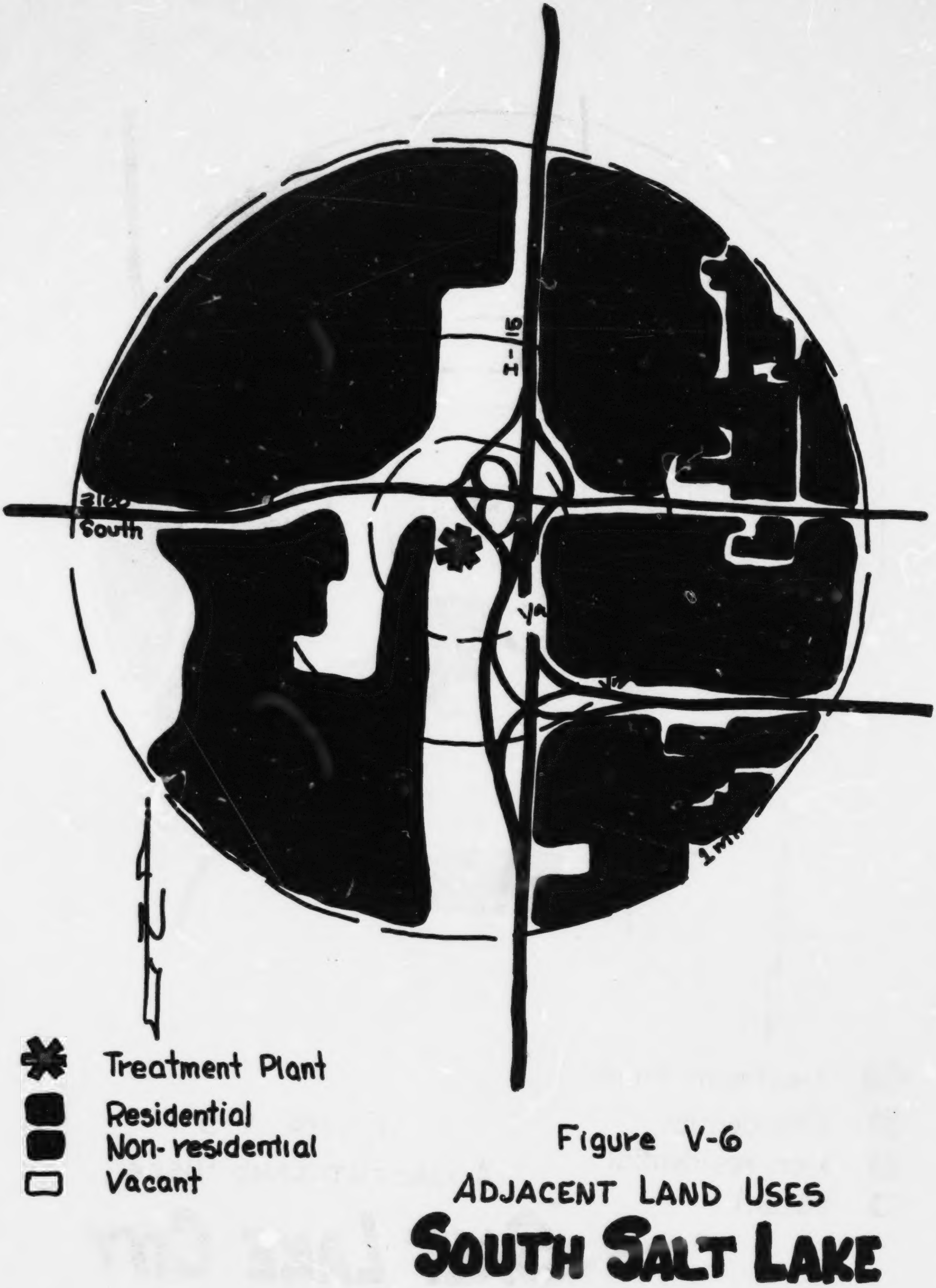

I-15
2100 South
1/4
1/2
1 mi
✱ Treatment Plant
■ Residential
■ Non-residential
☐ Vacant

Figure V-6

ADJACENT LAND USES

SOUTH SALT LAKE

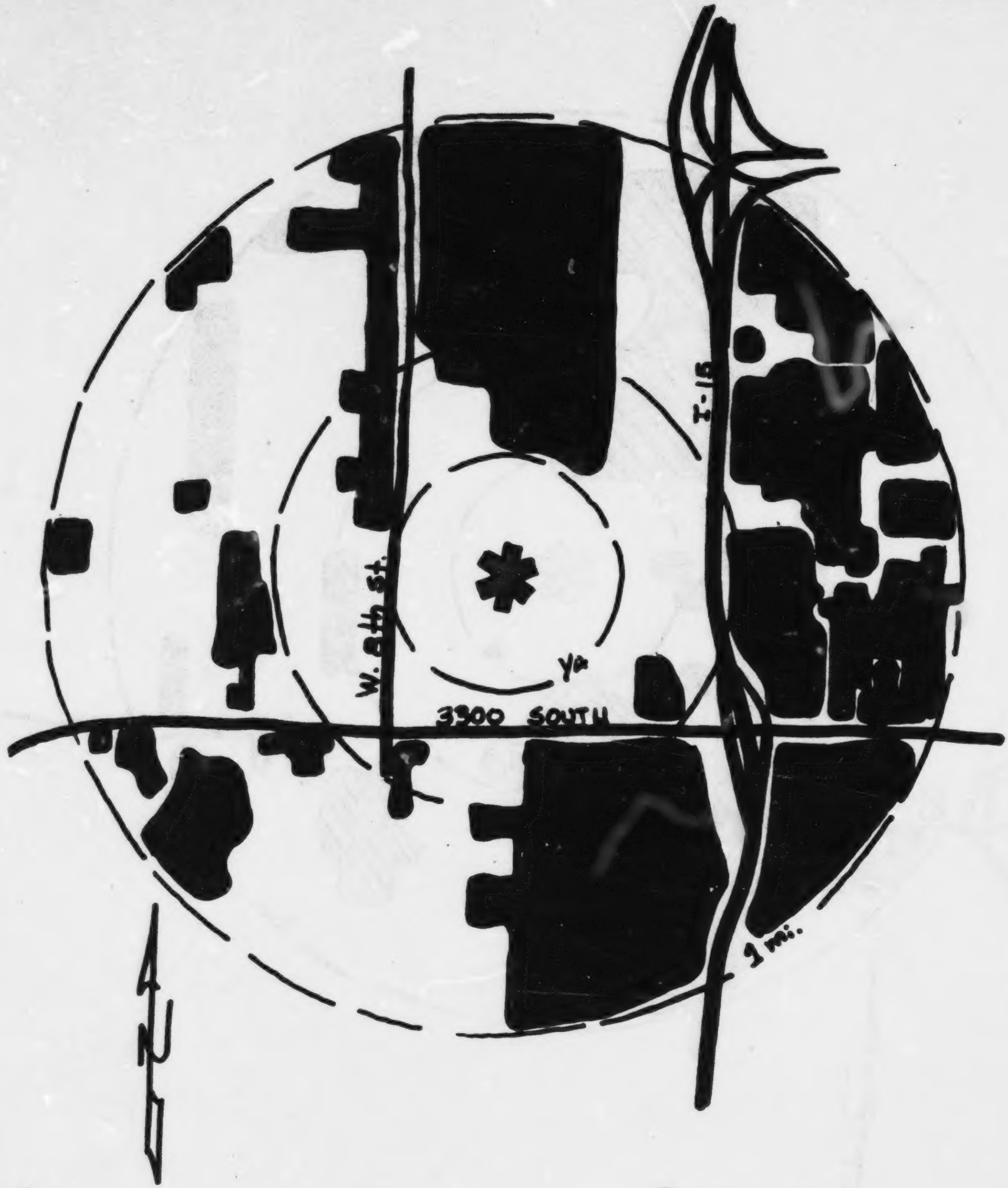

I-15
W. 8th St.
3300 SOUTH
½
1 mi.
N
✱ Treatment Plant
■ Residential
■ Non-residential
▭ Vacant

Figure V-7
ADJACENT LAND USES

SALT LAKE CITY
SUBURBAN #1

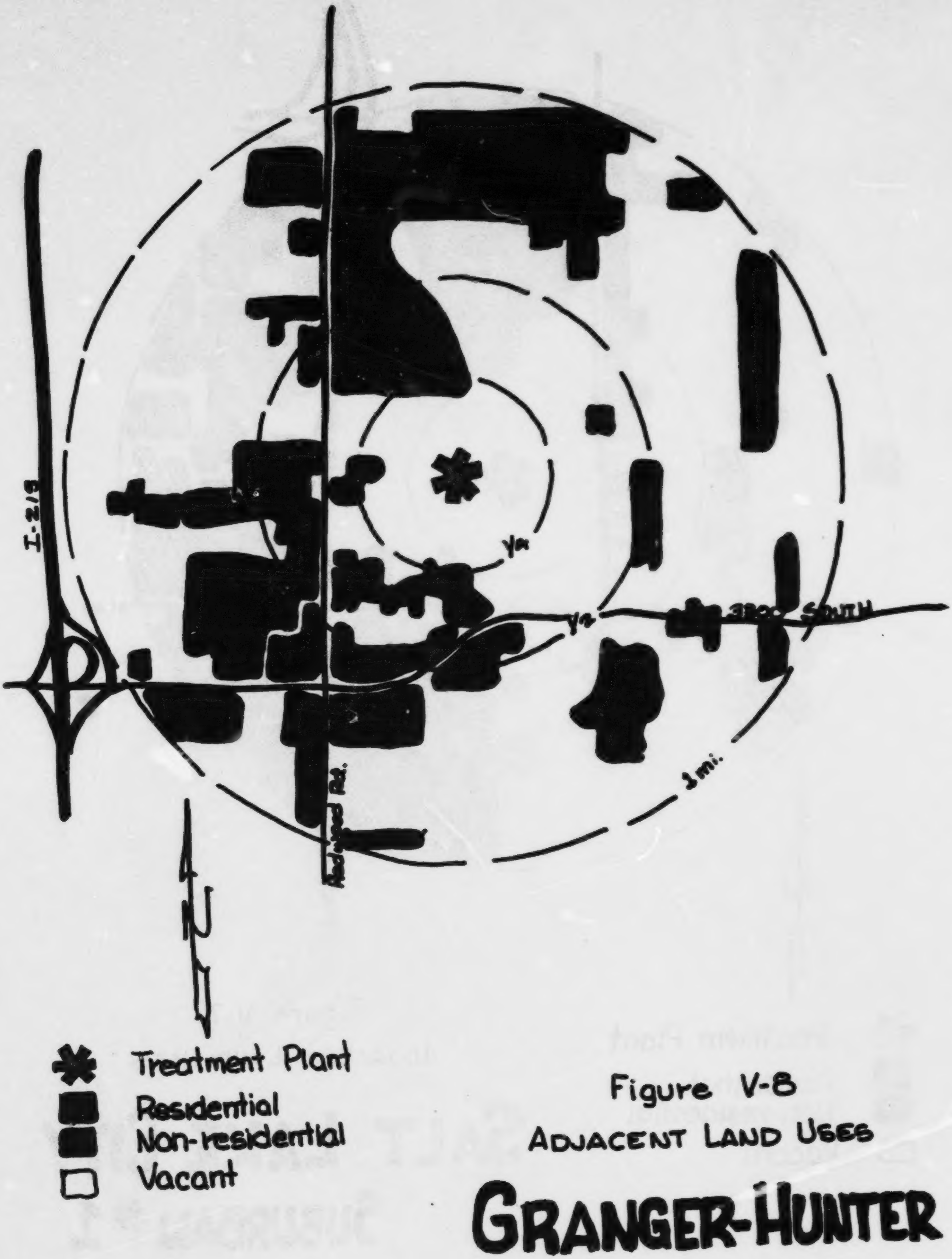
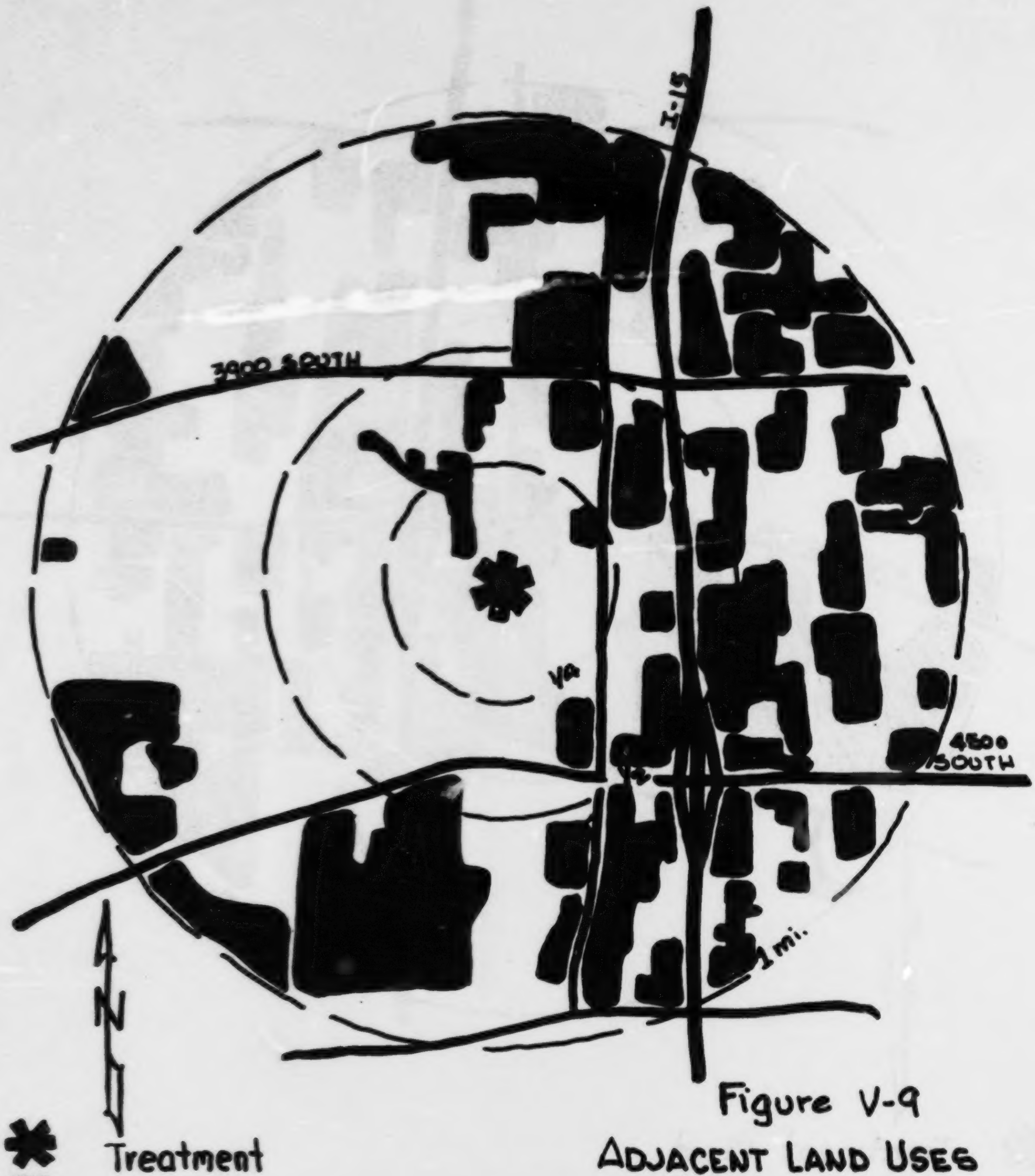

I-215
Redwood Rd.
3300 SOUTH
1/4 mi
1/2
1 mi.
N
✱ Treatment Plant
■ Residential
■ Non-residential
☐ Vacant

Figure V-8
ADJACENT LAND USES

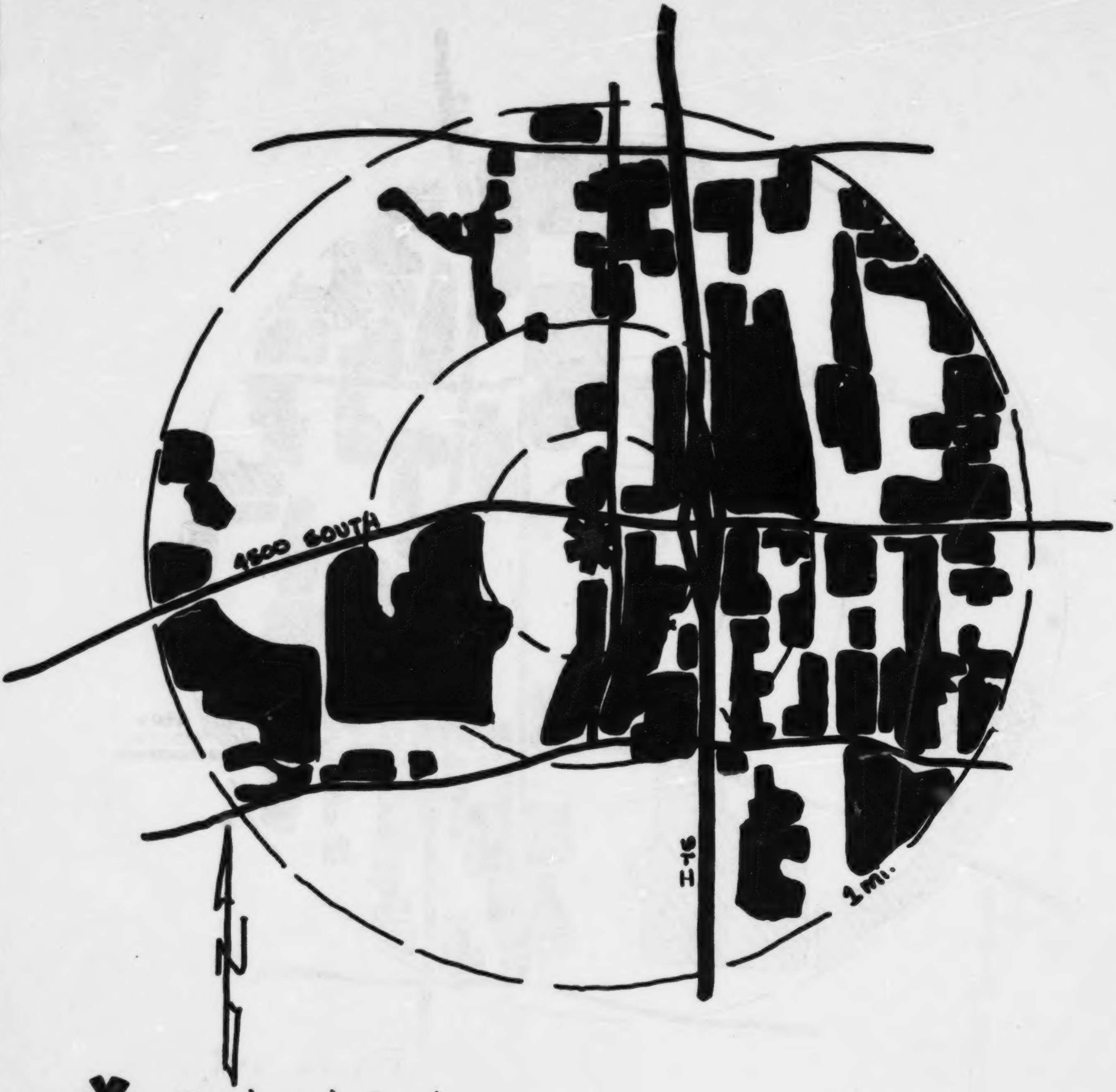
GRANGER-HUNTER


I-15
3900 SOUTH
VA
4500 SOUTH
1 mi.
N

✱ Treatment
■ Residential
● Non-residential
▭ Vacant

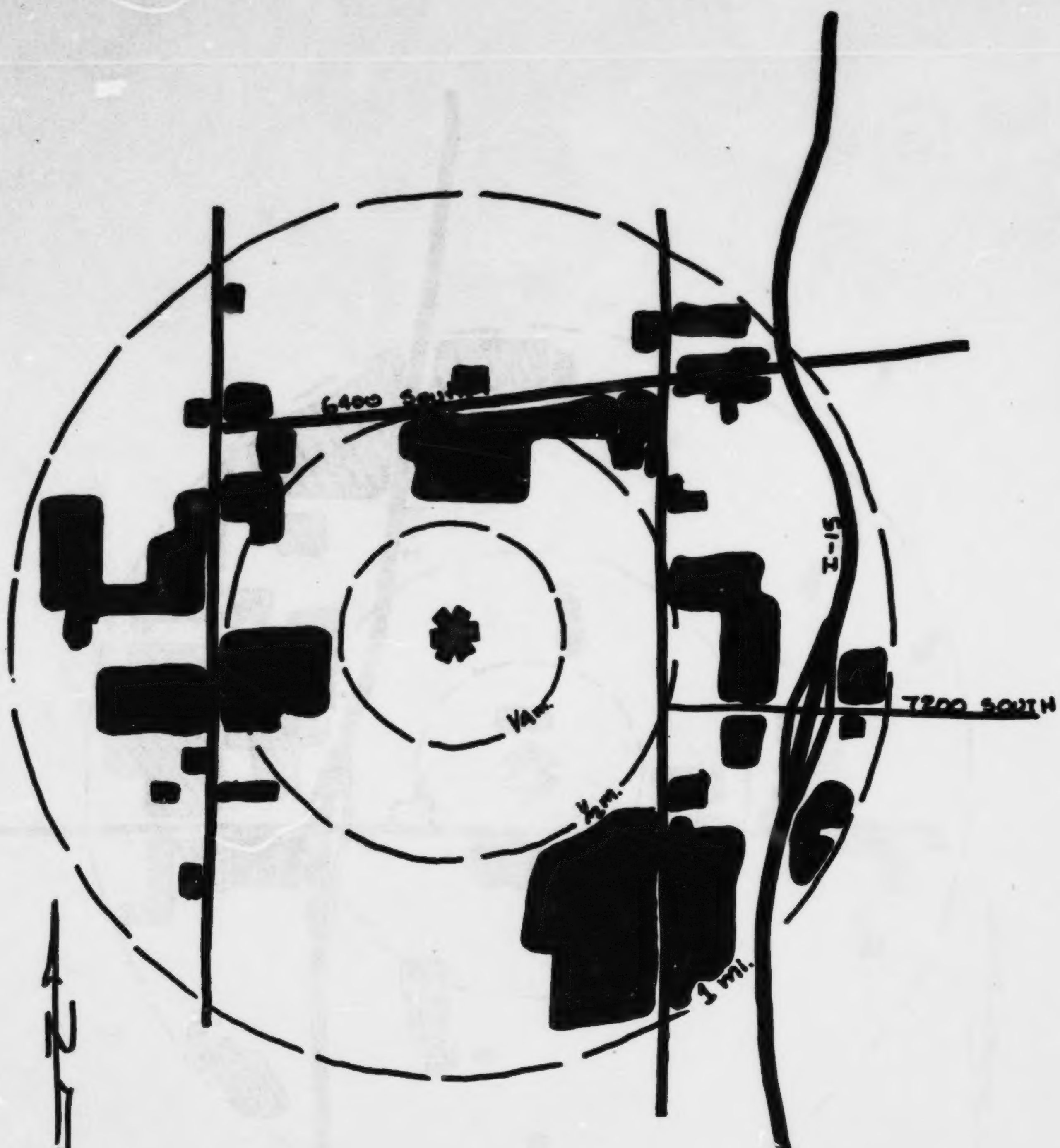
Figure V-9
ADJACENT LAND USES

SALT LAKE COUNTY
COTTONWOOD


4500 SOUTH
5TH
1 mi.
N

✱ Treatment Plant
■ Residential
■ Non-residential
□ Vacant

Figure V-10
ADJACENT LAND USES
MURRAY



6400 SOUTH
7200 SOUTH
I-15
¼ mi.
½ mi.
1 mi.
N
✱ Treatment Plant
■ Residential
■ Non-residential
▢ Vacant

Figure V-11
ADJACENT LAND USES

TRI-COMMUNITY

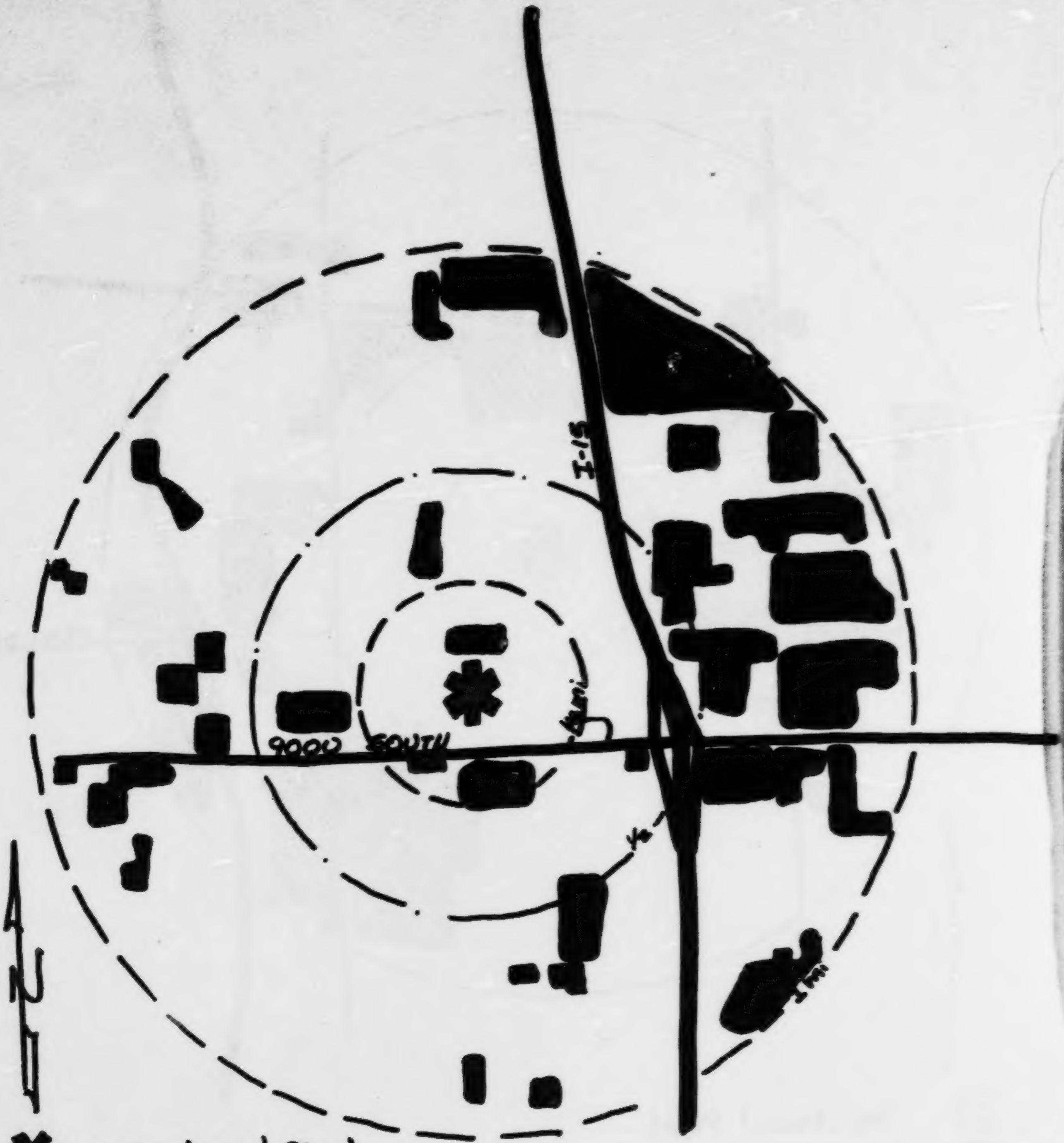

I-15
9000 SOUTH
½
1 mi
N
✱ Treatment Plant
■ Residential
■ Non-residential
☐ Vacant

Figure V-12
ADJACENT LAND USES
SANDY

TABLE V-3

ADJACENT LAND USE IMPACTS SALT LAKE COUNTY MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES

Alternate	Salt Lake City	South Salt Lake	Granger-Hunter	Salt Lake Sub. #1	Salt Lake County - Cottonwood	Murray	Tri-Community	Sandy
SLC-1	M/N	M/N	S	M/N	S/M	S	S/M	S/M
SLC-2	M/N	M/N	S	M/N	S/M	S	S/M	S/M
SLC-3	M/N	-	-	M*/N	S*/M	-	S*/M	-
SLC-4	M/N	-	-	M*/N	S*/M	-	S*/M	-
SLC-5	M/N	-	-	M*/N	-	-	S*/M	-
SLC-6	M/N	-	-	M*/N	-	-	-	-
SLC-7	M*/N	-	-	-	-	-	-	-
SLC-8	M*/N	-	-	-	-	-	-	-
SLC-9	M/N	-	-	M*/N	-	-	S*/M	-
SLC-10[1]	M/N	-	-	M*/N	-	-	-	-
SLC-11	M*/N	-	-	-	-	-	-	-
SLC-12	M*/N	-	-	M*/N	-	-	-	-

[1] Recommended plan.

Key:

S - Severe Adverse Impact
S/M - Severe to Moderate Impact
M/N - Moderate to Negligible Impact
N - Negligible Impact
* - Emphasis towards one End of Scale
- - Abandoned Facility
(see text for further discussion of criteria)

Northern Utah County

Land uses adjacent to existing wastewater treatment plants in Northern Utah County are illustrated in Figures V-13 to V-16. The American Fork facility has the most developed land in proximity to the treatment plant. Some residential development exists within ½ mile and some non-residential uses are within ¼ mile. Thus, adjacent land use impacts are rated severe to moderate. The remaining three facilities, Lehi, Pleasant Grove, and Orem, all have little or no development within ½ mile and are rated moderate to negligible.

Adjacent land use impacts for Northern Utah County facilities are presented in Table V-4. Alternatives NUC-8 and NUC-9 result in the least overall adverse adjacent land use impacts because they would limit land use impacts to the Orem site. Potential adverse impacts at new regional facilities such as those in NUC-5, NUC-6, NUC-7, NUC-10, NUC-11, and NUC-12 should be determined if and when the site is selected.

Central Utah County

Five sewage treatment plant sites are considered in Central Utah County. Land uses adjacent to these five facilities are illustrated in Figures V-17 to V-21. Of the five, only the Springville site manifests severe to moderate adverse adjacent land use impacts due to significant residential development within ½ mile of the facility. Payson has some residential development within one mile of the plant site, but like Provo, Spanish Fork, and Salem, most of the development within ½ mile is non-residential. Thus, these three facilities are rated moderate to negligible.

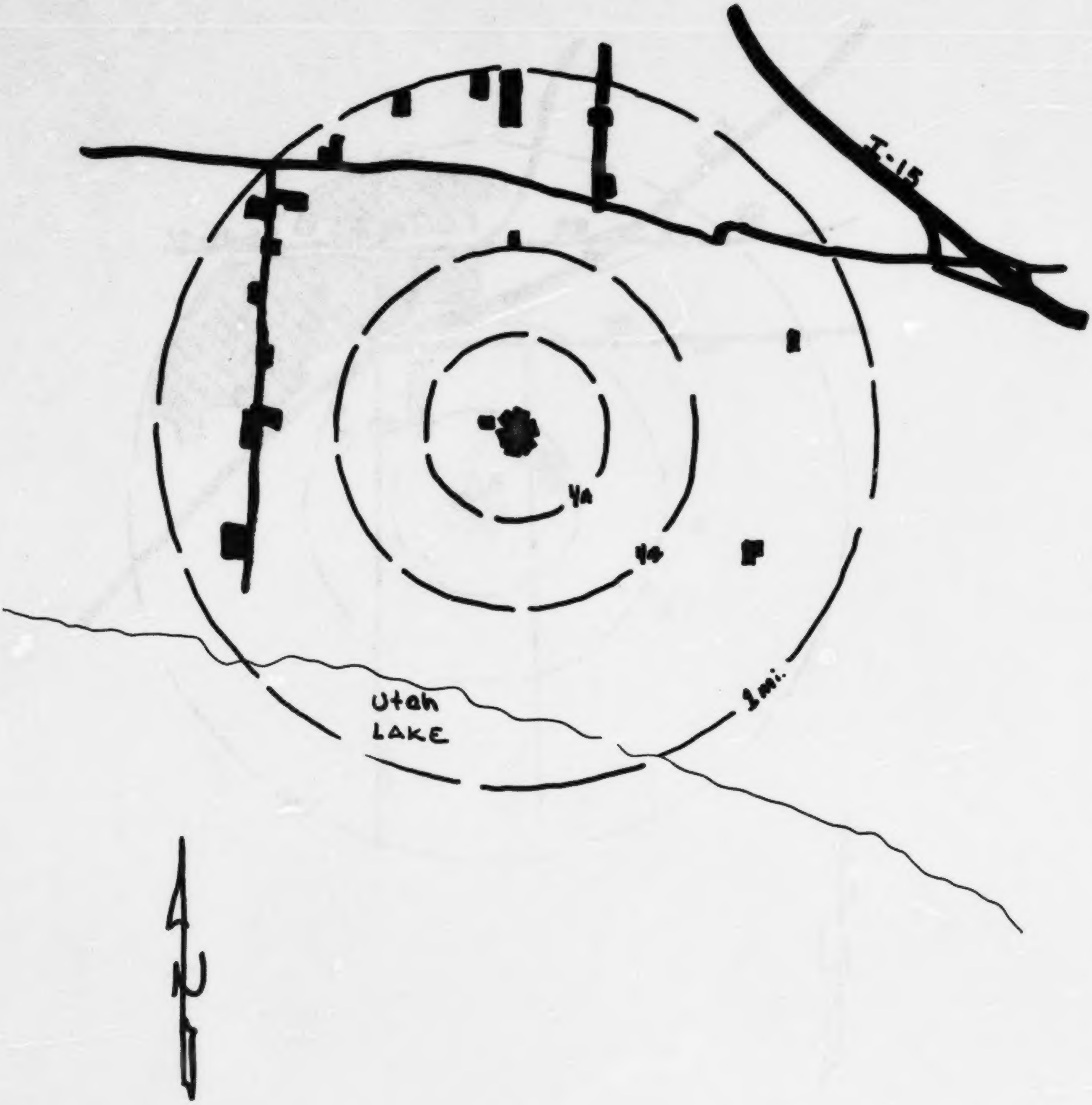
As presented in Table V-5, all Central Utah County alternatives manifest some moderate level impacts on adjacent land uses. Alternates CUC-10, CUC-11, and CUC-12 appear to have the least impacts on adjacent land use. For these alternatives, the Provo plant becomes the regional plant for the service area and residential uses are limited within ½ mile of this treatment site.

Wasatch County

As illustrated in Figure V-22, the Heber wastewater treatment facility has significant residential development within the ½ mile radius, thus adjacent land use impacts are judged severe to moderate. There is also some residential development within ½ mile of the Midway facility, Figure V-23, but not at the level manifested in Heber. For this reason, adjacent land use impacts at Midway are deemed moderate to negligible.

Adjacent land use impacts for Wasatch County wastewater treatment alternatives are presented in Table V-6. If significant growth occurs in the Wasatch County, Heber City-Midway area, Alternates WC-3, WC-4, WC-5, or WC-6 may solve the potential problems resulting from adjacent residential land uses. The regional site should be located one or more miles from any residential use.

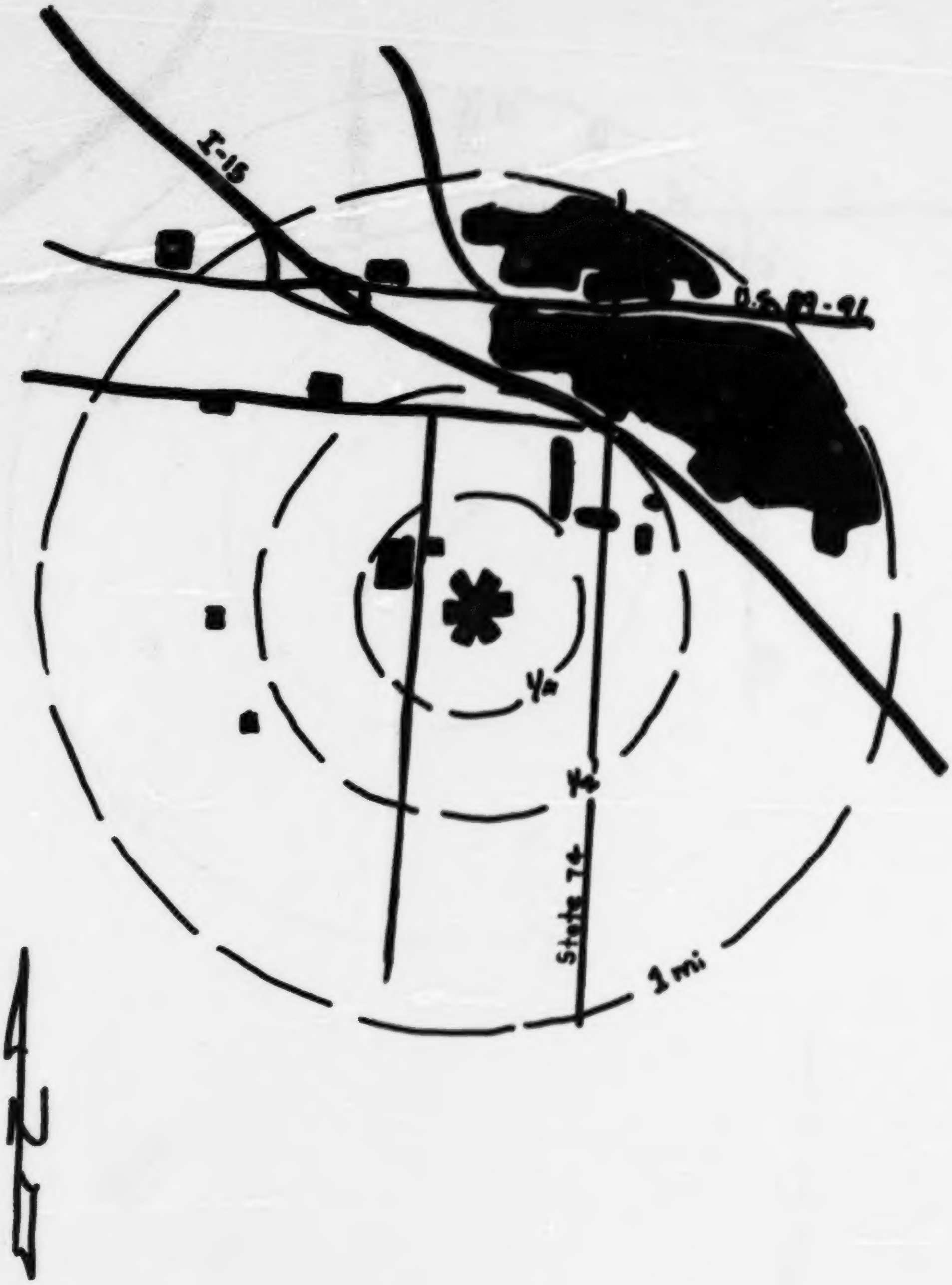
The existing Heber City plant is too near existing and potential development. Any expansion of this facility or expansion of housing on that side of the community would likely generate problems, detracting from the liveability of the community near the site. It must be kept in mind, however, that regionalization via WC-6 (Provo Canyon sewer) would mitigate land use impacts adjacent to the Heber and Midway facilities at the expense of land use development in Provo Canyon.


I-15
1/4
1/4
1 mi.
Utah
LAKE
N

✱ Treatment Plant
■ Residential
■ Non-residential
☐ Vacant

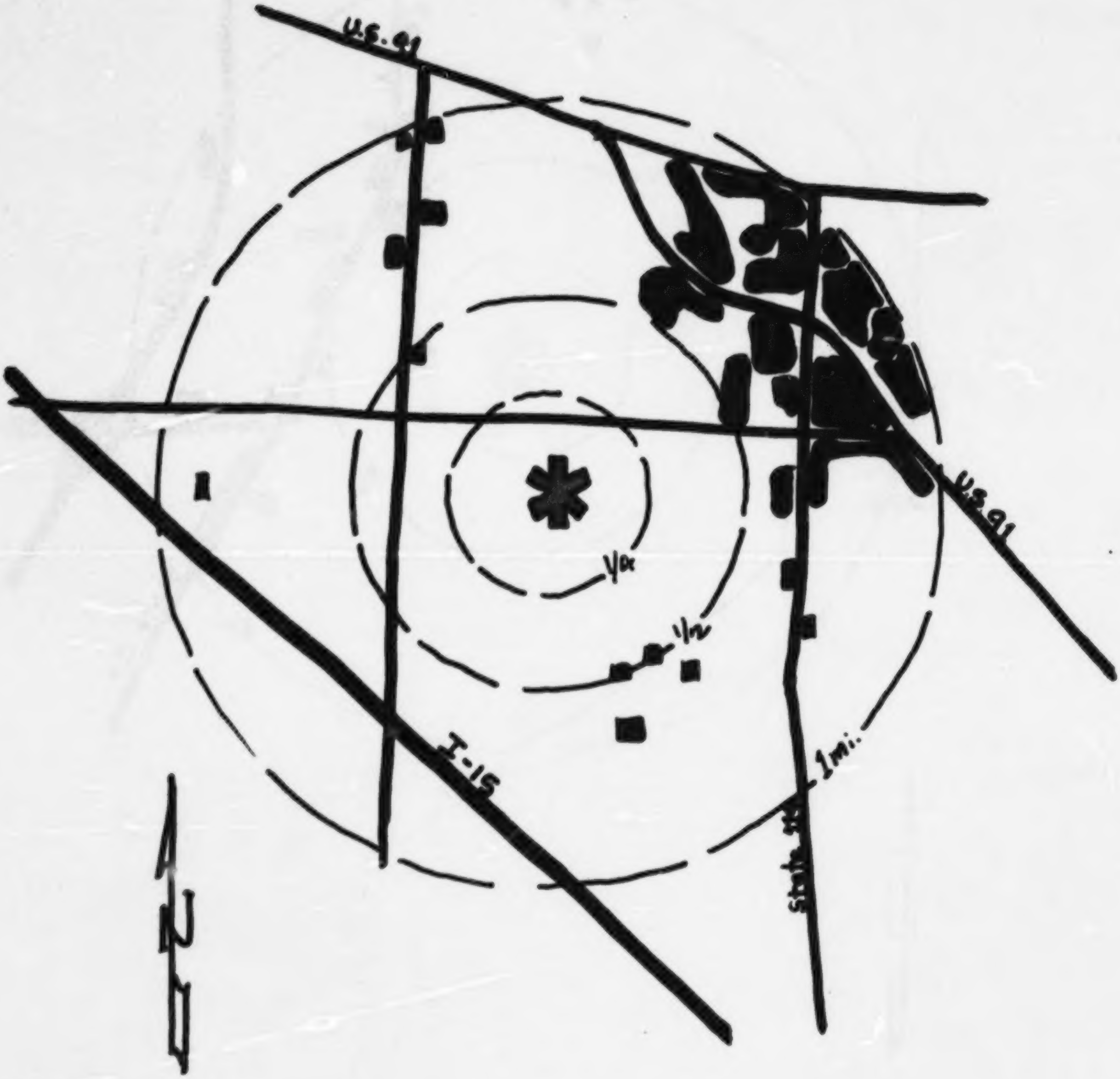
Figure V-13
ADJACENT LAND USES

LEHI


I-15
U.S. 89-91
1/4
1/2
State 74
1 mi
N

✱ Treatment Plant
■ Residential
■ Non-residential
☐ Vacant

Figure V-14
ADJACENT LAND USES
AMERICAN FORK


U.S. 91
U.S. 91
1/4
1/2
1 mi.
I-15
State
N

✱ Treatment Plant
■ Residential
■ Non-residential
▭ Vacant

Figure V-15
ADJACENT LAND USES

PLEASANT GROVE

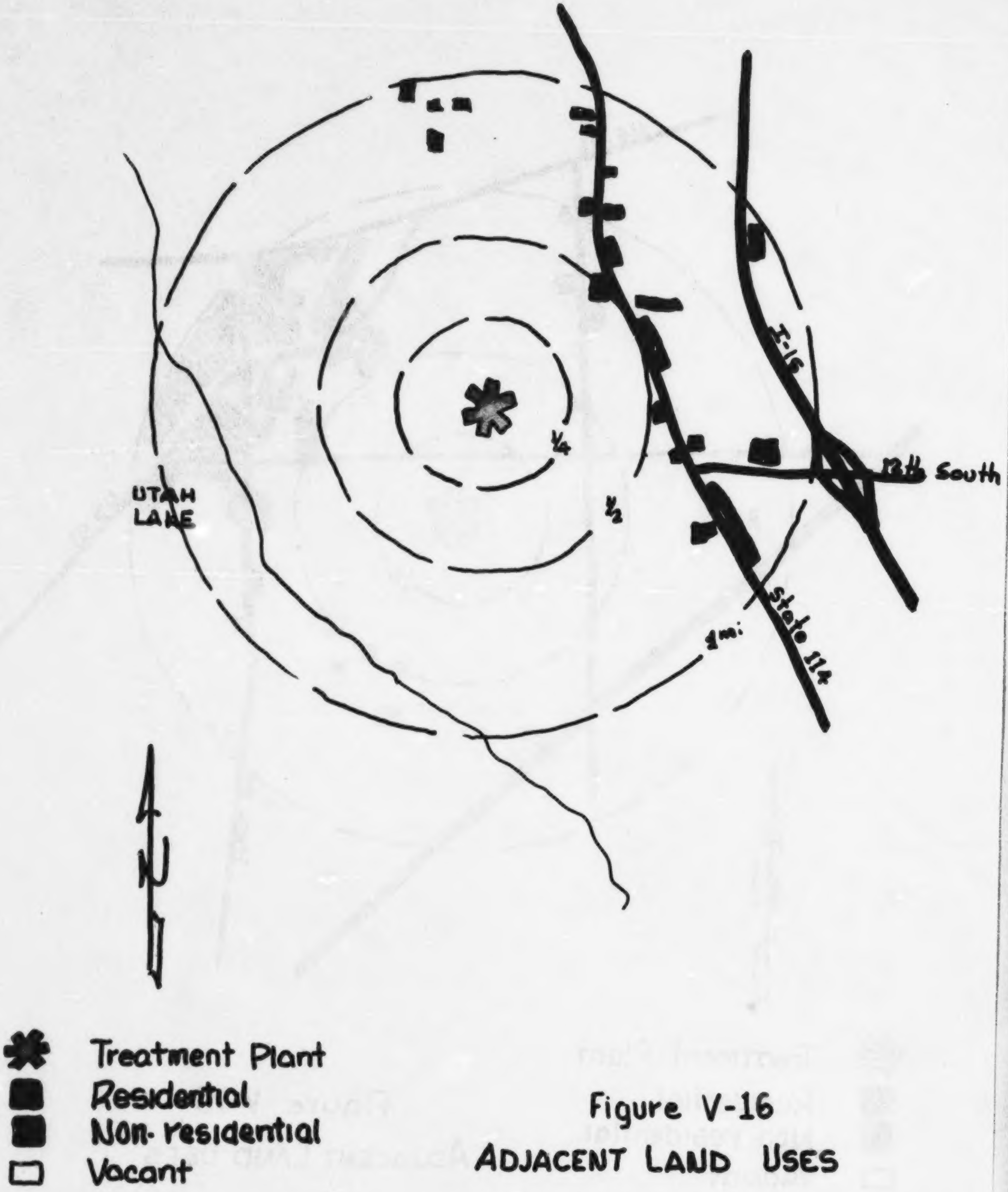

UTAH LAKE
1/4
1/2
1 mi
I-15
13th South
State 114
N
✱ Treatment Plant
■ Residential
■ Non-residential
☐ Vacant

Figure V-16
ADJACENT LAND USES

OREM

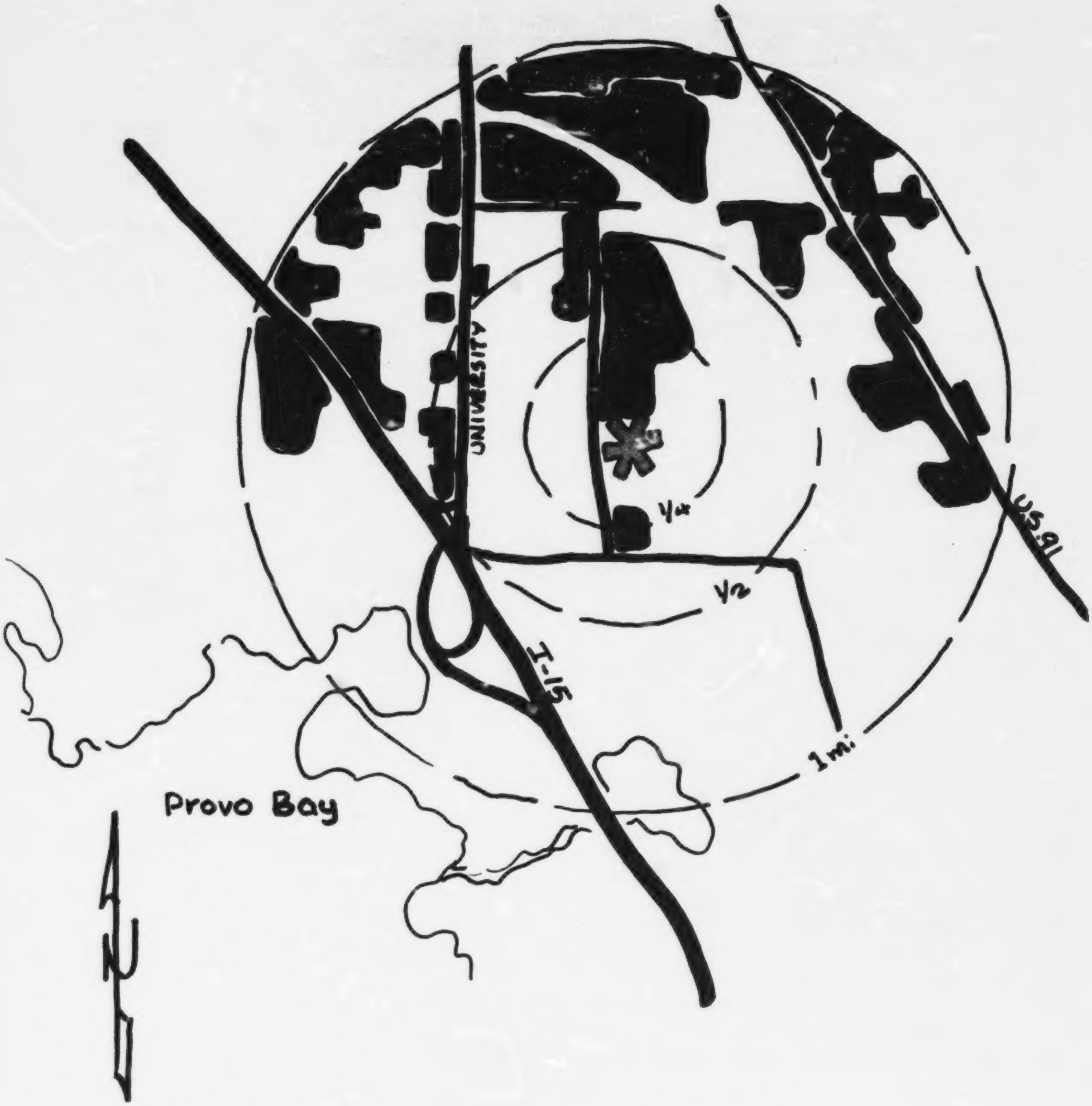
TABLE V-4

ADJACENT LAND USE IMPACT NORTH UTAH COUNTY MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES

Alternate	Lehi	American Fork	Pleasant Grove	Orem
NUC-1	M/N	S/M	M/N	M/N
NUC-2	M/N	S/M	M/N	M/N
NUC-3	M/N	S/M	M/N	M/N
NUC-4	M/N	S/M	M/N	M/N
NUC-5	-	S*/M	-	M/N
NUC-6	-	S*/M	-	M/N
NUC-7	-	N	-	M/N
NUC-8	-	-	-	M*/N
NUC-9	-	-	-	M*/N
NUC Recommended Plan	-	S*/M	-	M/N

Key:

S - Severe Adverse Impact
S/M - Severe to Moderate Impact
M/N - Moderate to Negligible Impact
N - Negligible Impact
* - Emphasis towards one End of Scale
- - Abandoned Facility
(see text for further discussion of criteria)


UNIVERSITY
U.S. 91
1/4
1/2
I-15
1 mi.
Provo Bay
N

✱ Treatment Plant
■ Residential
■ Non-residential
☐ Vacant

Figure V-17
ADJACENT LAND USES

PROVO

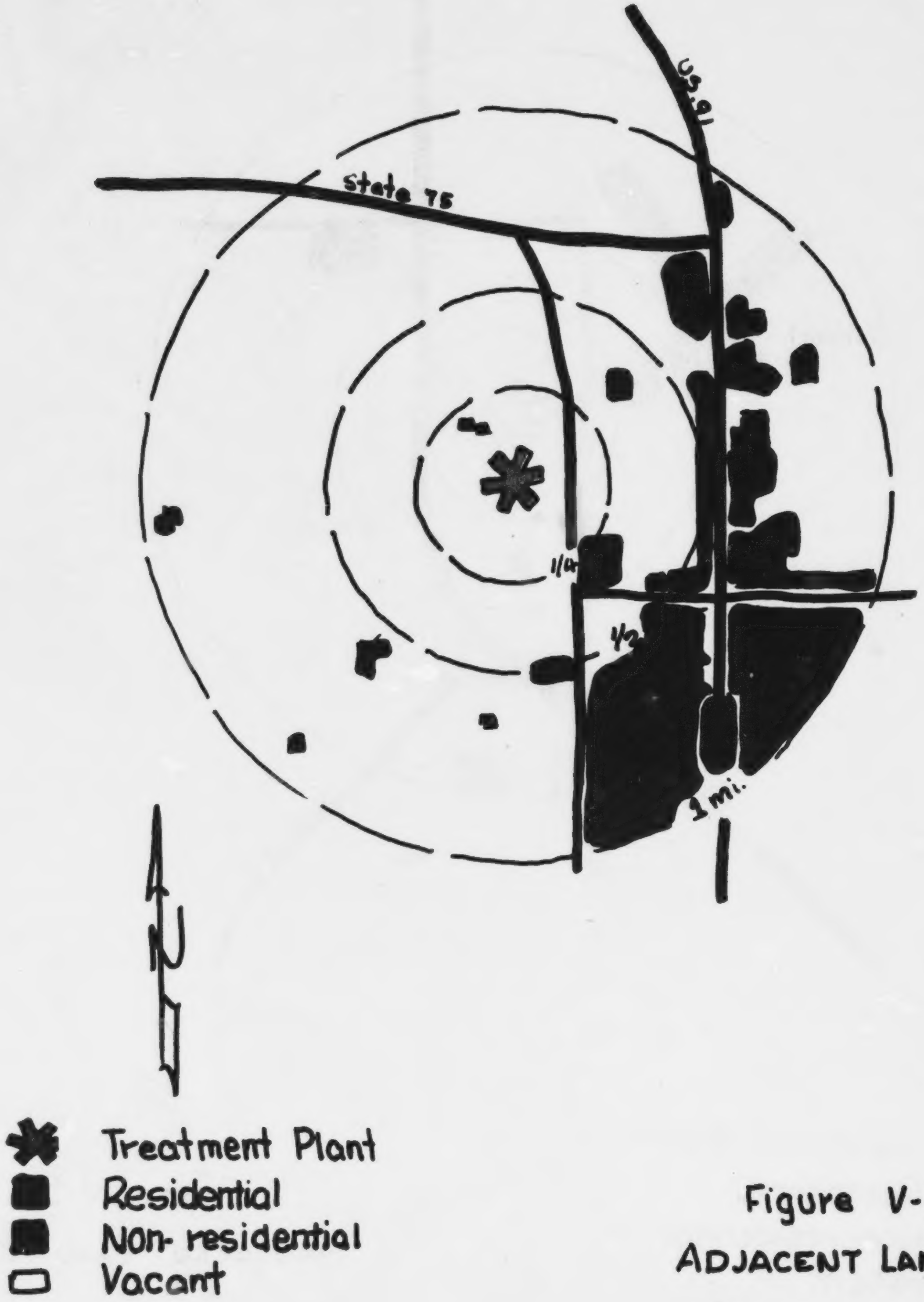

US 91
State 75
1/4
1/2
1 mi.
N
✱ Treatment Plant
■ Residential
■ Non-residential
▭ Vacant

Figure V-18
ADJACENT LAND USES

SPRINGVILLE

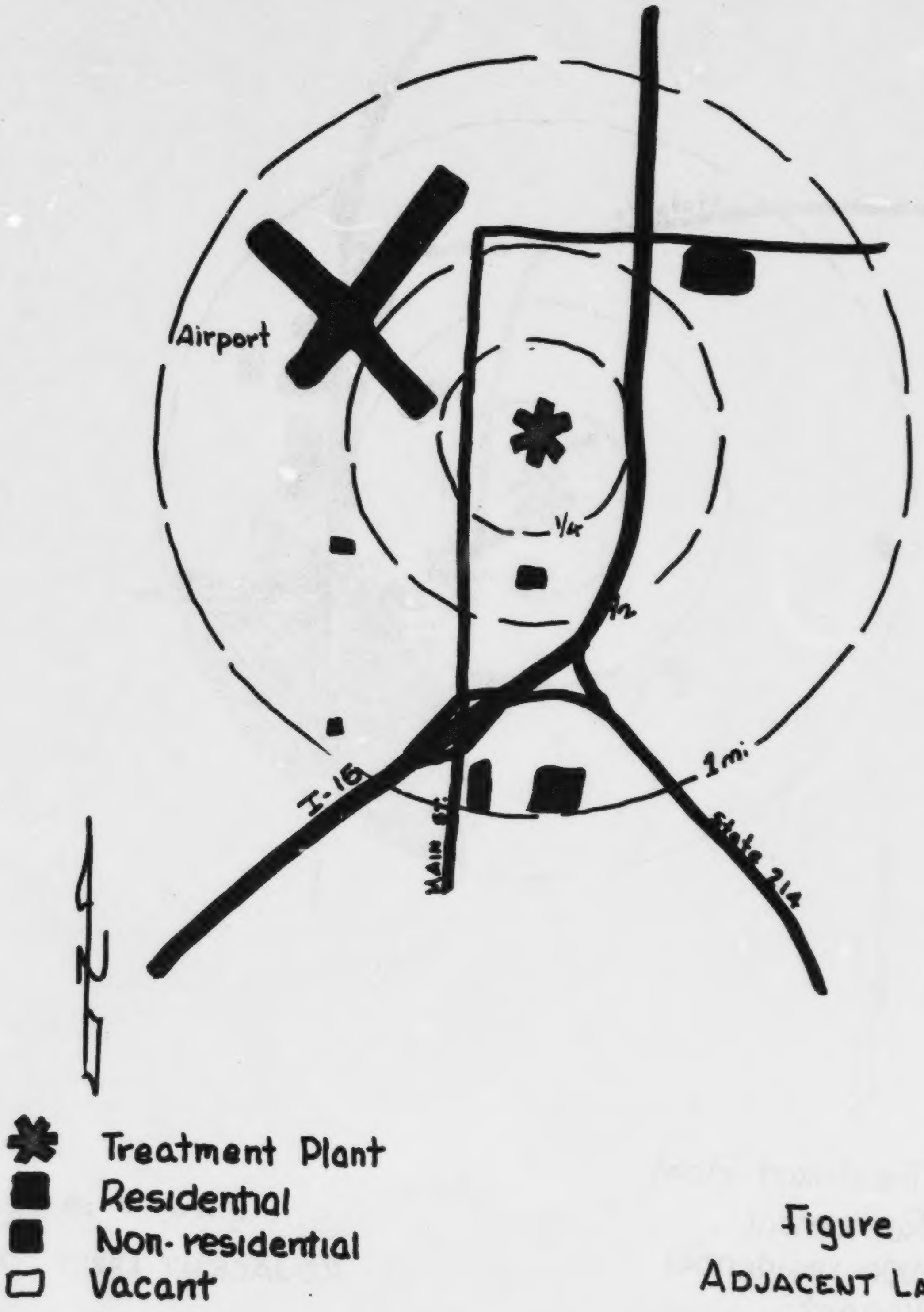
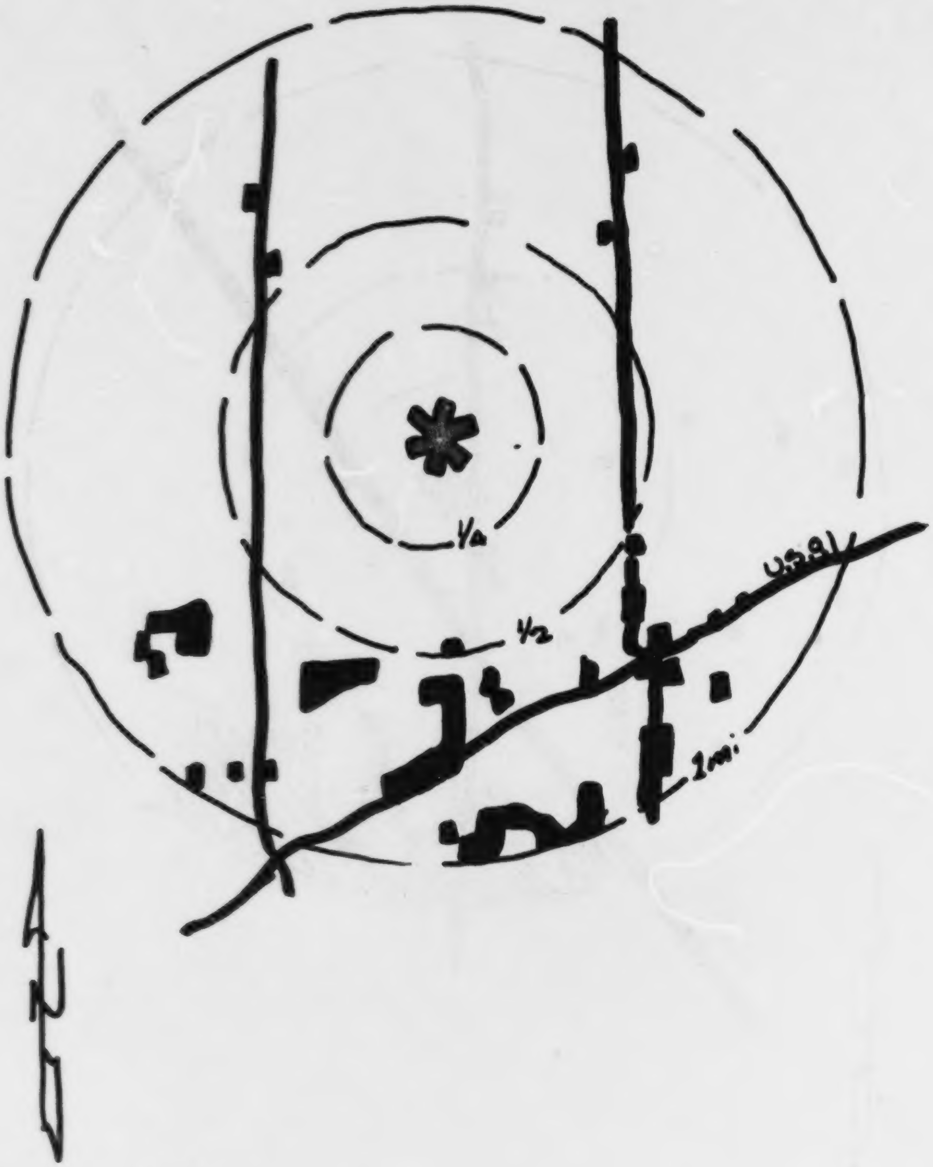
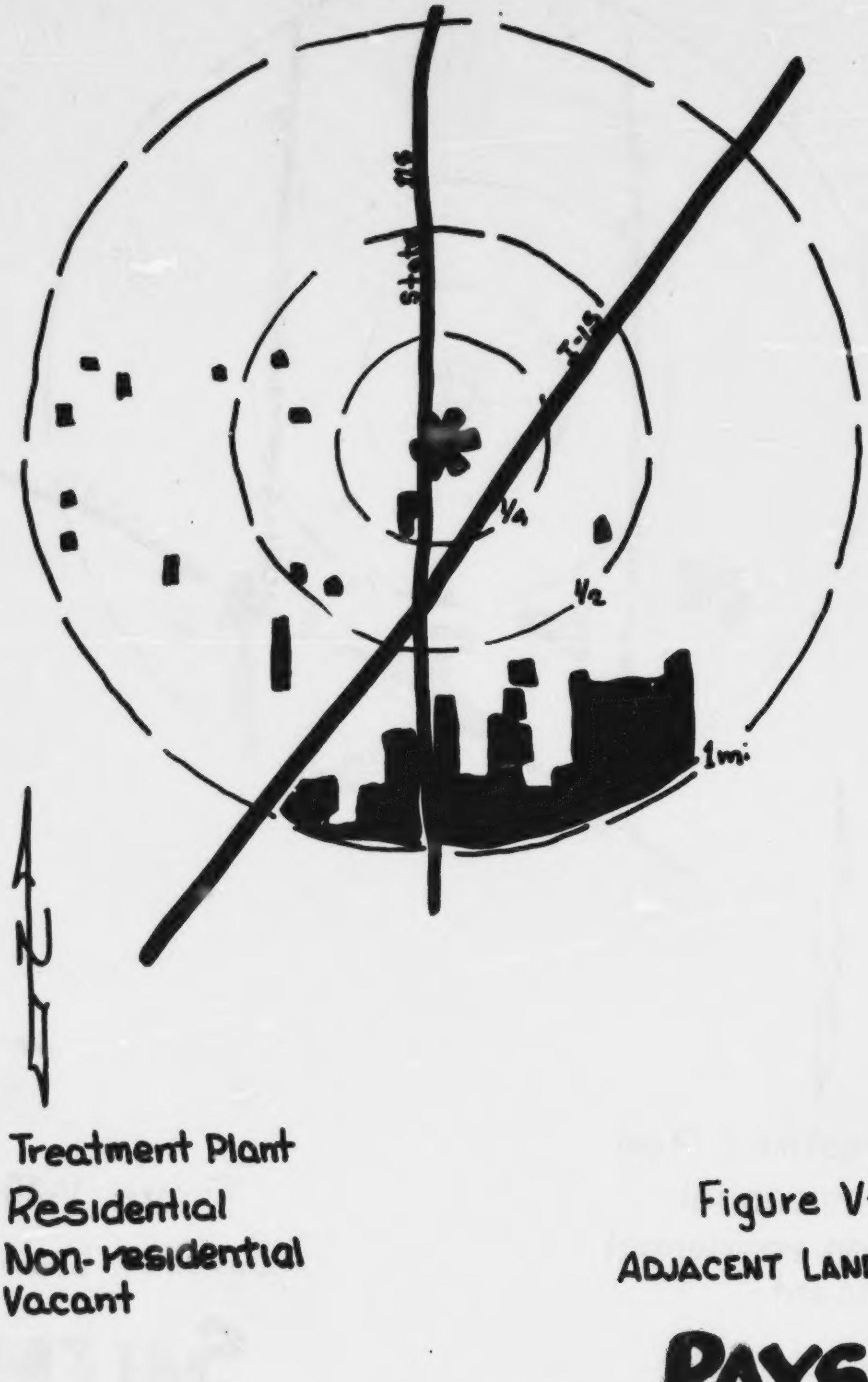

Airport
1/4
1/2
1mi
I-15
Main St.
State 214
N
Treatment Plant
Residential
Non-residential
Vacant

Figure V-19
ADJACENT LAND USES
SPANISH FORK


1/4
1/2
1mi
U.S.91
N

✱ Treatment Plant
■ Residential
■ Non-residential
☐ Vacant

figure V-20
ADJACENT LAND USES
SALEM



State 115
I-15
1/4
1/2
1mi
N
✱ Treatment Plant
▨ Residential
■ Non-residential
☐ Vacant

Figure V-21
ADJACENT LAND USES

PAYSON

TABLE V-5

ADJACENT LAND USE IMPACT CENTRAL UTAH COUNTY MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES

Alternate	Provo	Springville	Spanish Fork	Salem	Payson
CUC-1	M/N	S/M	M/N	M/N	M/N
CUC-2	M/N	S/M	M/N	M/N	M/N
CUC-3	M/N	S/M	M/N	-	M*/N
CUC-4	M/N	S/M	M/N	-	M*/N
CUC-5	M*/N	S/M	-	M/N	M/N
CUC-6	M*/N	-	-	M/N	M/N
CUC-7	M*/N	-	-	M/N	M/N
CUC-8	M*/N	-	M/N	M/N	M/N
CUC-9	M*/N	-	M/N	M/N	M/N
CUC-10	M*/N	-	-	-	-
CUC-11	M*/N	-	-	-	-
CUC-12	M*/N	-	-	-	-
CUC Recommended Plan	M*/N	-	-	-	M*/N

Key:

S	-	Severe Adverse Impact
S/M	-	Severe to Moderate Impact
M/N	-	Moderate to Negligible Impact
N	-	Negligible Impact
*	-	Emphasis towards one End of Scale
-	-	Abandoned Facility

(see text for further discussion of criteria)

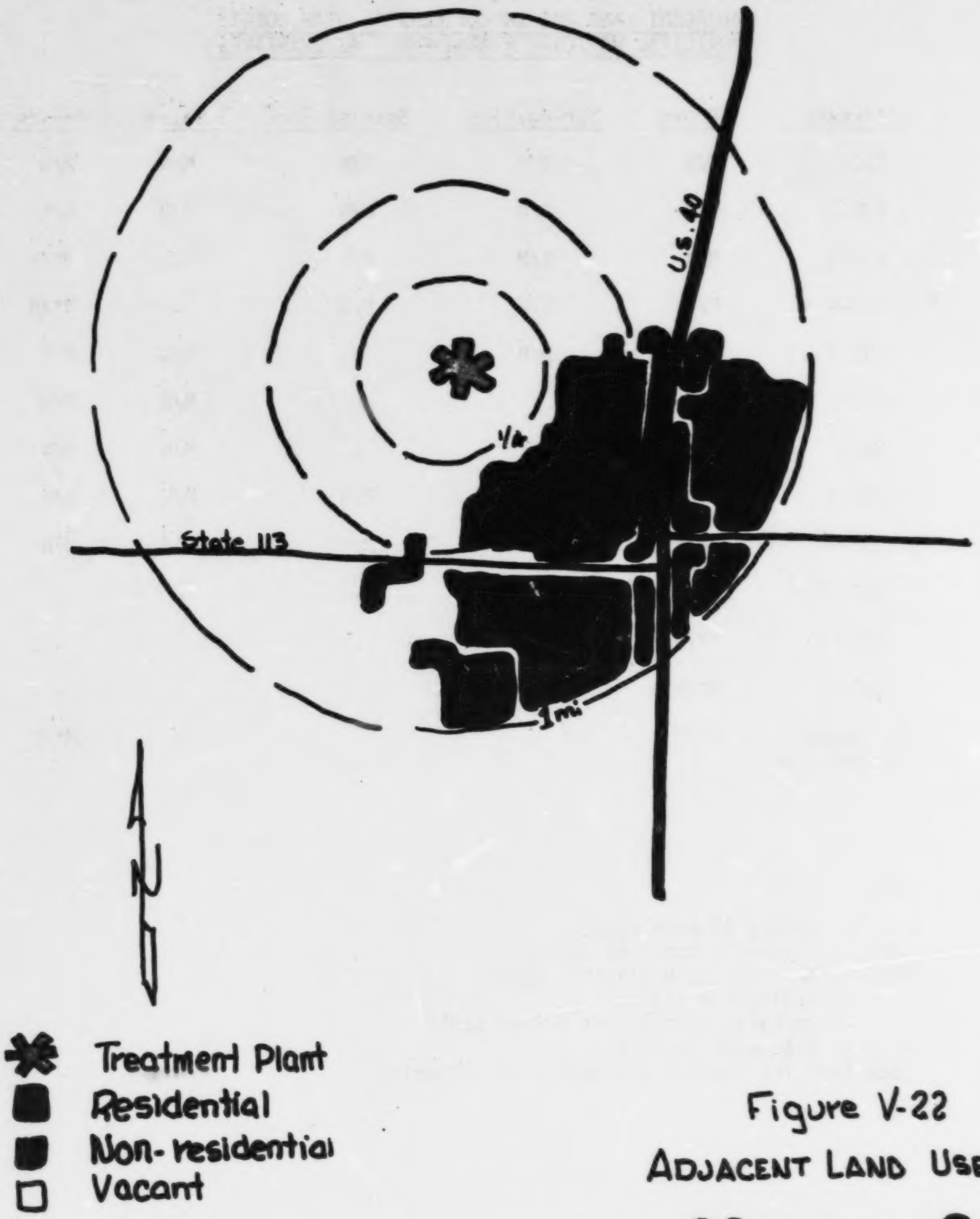
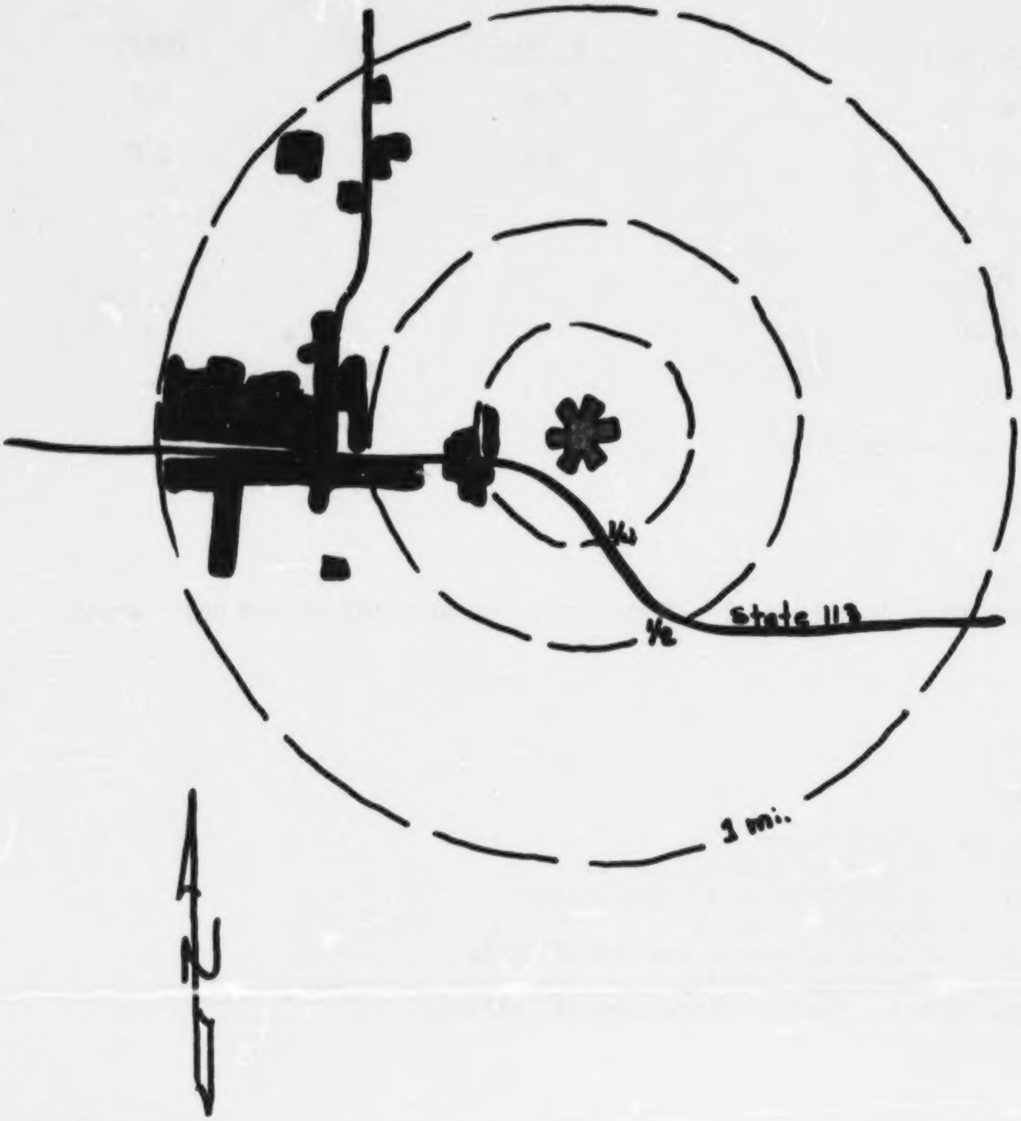

U.S. 40
State 113
1/4
1mi
N
Treatment Plant
Residential
Non-residential
Vacant

Figure V-22
ADJACENT LAND USES

HEBER CITY


State 113
1/4
1/2
1 mi.
N

✱ Treatment Plant
■ Residential
■ Non-residential
☐ Vacant

Figure V-23
ADJACENT LAND USES

MIDWAY

TABLE V-6

ADJACENT LAND USE IMPACT WASATCH COUNTY MUNICIPAL WASTEWATER MANAGEMENT ALTERNATIVES

Alternate	Midway	Heber
WC-1	M/N	S/M
WC-2	M/N	S/M
WC-3[1]	-	-
WC-4[1]	-	-
WC-5[1]	-	-
WC-6	-	-
WC Recommended Plan[1]	-	-

[1] New plant located at Charleston to serve both Midway and Heber areas.

Key:

S - Severe Adverse Impact
S/M - Severe to Moderate Impact
M/N - Moderate to Negligible Impact
N - Negligible Impact
* - Emphasis towards one End of Scale
- - Abandoned Facility
(see text for further discussion of criteria)

Flood Hazards

Flooding of treatment plants can create potential pollution from bypassing of raw or improperly treated sewage. Other adverse impacts include damage to equipment, plant shutdowns, and the additional cost of flood protection and flood-proofing.

Based on Corps of Engineers and Salt Lake County flood plain studies, the Murray and Tri-Community wastewater treatment facilities could be inundated by the Standard 100 year and/or the 250 year flood. Currently, a slag dike affords some protection for the Tri-Community facility, but this structure is not sufficient to prevent flooding caused by the 100 year or 250 year floods. The Tri-Community facility is recommended as a regional wastewater treatment plant in Alternatives SLC-3, SLC-4, SLC-5, and SLC-9, and the potential impacts of a flood would be magnified if any of these alternatives were implemented.

The Murray facility will be affected by the 100 year flood only if debris at the 4500 Street South bridge causes an obstruction to flood flow. However, the 250 year flood will cause damage at Murray under any circumstance. The Murray facility is maintained in Alternatives SLC-1 and SLC-2.

TERRESTRIAL ECOSYSTEM IMPACTS

Impacts on the natural terrestrial ecosystem of the Study Area have been divided into two categories:

1. Localized direct impacts result from the direct influence of plan implementation in the area of sewage works. Short-term direct impacts are associated with construction activities while long-term impacts relate to the disruption of the natural ecosystem over the life of the project.
2. Indirect ecosystem impacts are the result of growth and development related to plan implementation. These impacts are more difficult to assess because of the unpredictability of future development patterns.

Localized ecosystem impacts resulting from implementation of wastewater treatment alternatives are presented in Table V-7. The types of impacts can be divided into three groups which depend on the nature of the treatment alternative:

- A - modification and expansion of existing treatment facilities will tend to impact a very small sphere of influence surrounding the facility. Such construction will induce localized short-term impacts, but long-term impacts would be minimal. The natural environment adjacent to existing facilities has undergone and adjusted to the stresses of construction and operation of the plant.
- B - the next level of ecosystem impact results from those treatment alternatives which include the upgrading and expansion of existing facilities and the construction of new outfall lines or the consolidation of facilities with associate interceptor construction. In addition to the short-term localized impacts described in "A," there is the potential for severe short and long-term impacts resulting from construction of outfalls,

interceptors, and/or expanded regional plants. In most cases, new outfalls will cross virgin land, disrupting natural habitat during construction, and possibly permanently altering the pre-construction habitat. Major interceptor corridors will adversely affect terrestrial ecosystems during construction, particularly in undeveloped areas, and may have a long term impact resulting from the elimination of natural intolerant vegetal communities and the introduction of undesirable, tolerant, weedy vegetation. Regional facilities will require more land, thereby increasing the probability of ecosystem disruption.

C - If consolidation occurs and new regional treatment facilities are constructed, possibly with long outfalls, localized terrestrial ecosystem impacts are likely to be most severe. Under these alternatives, the greatest amount of new land is being committed to sewage works and, thus, is removed from the natural terrestrial habitat.

The size of the area to be consolidated, the length of the required connecting interceptors, and the type of habitat to be crossed all influence the severity of the adverse impacts discussed above. In addition to the above classifications, the following code was used in Table V-7 to identify the severity of these impacts:

- S - smaller land commitment, short connecting distances, potential adverse impacts are low.
- M - moderate land commitment and connecting distances, potential adverse impacts are moderate.
- L - large land commitment and connecting distances, potential adverse impacts are great.

The types of short term, construction related impacts presented in Table V-7 include the generation of sediment loads, noise, and particulate matter. These factors may drive animals and bird life from the area, inducing pressure in other habitat areas. Air pollution from construction may stunt or kill vegetation in the immediate area, thus reducing habitat utility.

Archaeological sites occur throughout the entire region. At the level of planning available, it is not possible to determine which alternatives would affect known archaeological sites, however, alternative sewerage systems believed to be located near archaeological sites have been noted in Table V-7. Prior to construction, an archaeological reconnaissance of the area would be required. In the event artifacts were discovered during construction, work should be halted and the Utah State Historical Officer should be contacted.

Currently no designated historical sites are expected to be affected by implementation of any alternative.

Indirect terrestrial ecosystem impacts resulting from implementation of wastewater treatment alternatives and associated development patterns are presented in Table V-8. In assessing these development related impacts, consideration was given to the fact that, without strict land use controls, additional treatment plant capacity and major interceptors may induce scattered or sprawl development, thereby destroying terrestrial ecosystem habitat.

TABLE V-7

DIRECT ECOSYSTEM IMPACTS

Alternative	Localized[1] Impact	Comments
DAVIS COUNTY		
DC-1, DC-2	A	
DC-3, DC-4	B	. Commits Great Salt Lake to assimilate effluent directly for life of facility. . Outfalls may permanently alter marsh communities during construction to a point of no return.
DC-5, DC-6	B/L	. Commits Great Salt Lake to assimilate effluent directly for life of facility. . Interceptor may disrupt grass-sagebrush habitat types. . Interceptor may disrupt archaeological site.
DC-7, DC-8	B/M	. Same as DC-5, DC-6. . Interceptor may inhibit animal movement on corridor micro-environment.
DC-9	B/L	. Construction and long term commitment may severely disrupt Farmington Bird Refuge. . Commits corridor through Farmington Bird Refuge to sewer system. . Potential loss of waterfowl and marsh habitat. . Commits Great Salt Lake to assimilate effluent directly for life of facility. . Interceptor may disrupt archaeological site.
DC-10	B/S	. Same as DC-5, DC-6.
DC-12, DC-13	B/M	. Same as DC-7, DC-8. . If interceptor is located near Jordan River, disruption of streambank and riparian ecosystem is possible.
DC-Rec. Plan	B/M	. Interceptor may disrupt grass-sagebrush habitat types. . Interceptor may inhibit animal movement on corridor micro-environment. . Interceptor may disrupt archaeological site.
SALT LAKE COUNTY		
SLC-1, SLC-2	A	
SLC-3, SLC-4, SLC-5, SLC-9	B/S	. Interceptor line crosses Jordan River - disrupt streambank habitat types.

TABLE V-7 (Continued)

DIRECT ECOSYSTEM IMPACTS

Alternative	Localized[1] Impact	Comments
SALT LAKE COUNTY (Con't)		
		. Interceptor along Jordan River may further disrupt stream bank communities. . Interceptor may disrupt archaeological site.
SLC-6, SLC-10	B/M	. Same as above; interceptor has long corridor thus greater area for impacts to be demonstrated.
SLC-7, SLC-11	B/L	. Same as above.
SLC-8	B/L	. Commits Great Salt Lake to assimilate effluent directly for life of facility. . Disrupts Great Salt Lake marshlands. . Interceptor commits urban and rural land for wastewater conveyance. . Interceptor may disrupt archaeological site.
SLC-12	B/M	. Same as SLC-8.
SLC-Rec. Plan	B/L	. Interceptor may have great impact on habitat areas from Camp Williams to Murray. . Two crossings of Jordan River - disrupting stream banks. . Interceptor may disrupt archaeological site.
NORTHERN UTAH COUNTY		
NUC-1, NUC-2	A	
NUC-3, NUC-4	B	. Outfalls commit north end of Utah Lake to assimilate direct discharge of effluents. . Potential disruption of marshland due to construction and maintenance of outfall.
NUC-5, NUC-6	B/M	. Disruption of grass-sagebrush due to interceptor construction. . Micro-environment of interceptor corridor likely to be disrupted.
NUC-7	B/M	. Commit northern end of Utah Lake to assimilate direct discharge of effluents. . Potential disruption of Lake shore marshlands during construction and maintenance of outfall. . Same as NUC-5, NUC-6.

TABLE V-7 (Continued)

DIRECT ECOSYSTEM IMPACTS

Alternative	Localized[1] Impact	Comments
NORTHERN UTAH COUNTY (Con't)		
NUC-8	B/L	. Commits Utah Lake to assimilate effluents of four urban areas directly. . Potential disruption of shore line marshland. . Obligates long interceptor corridors to sewerage works.
NUC-9	B/L	. Commits long interceptor corridors to sewerage works.
NUC-10	C/L	. Commits land for facility and long interceptor line corridors and outfall line. . Commits Utah Lake to assimilate efflunet discharge directly. . Potential disruption of shoreline-marshland. . Disruption to Provo River stream banks due to river crossing. . Outfall may disrupt archaeological sites.
NUC-11, NUC-12	C/L	. Same as NUC-10. . Discharge of effluent is directly to Provo Bay. . Potential disruption of Provo Bay ecosystem dynamics with outfall construction.
NUC-Rec. Plan	B/M	. Same as NUC-5, NUC-6.
CENTRAL UTAH COUNTY		
CUC-1, CUC-2	A	
CUC-3, CUC-4	B/S	. Interceptor corridor could disrupt particular habitat types of grass-sagebrush ecosystem. . Interceptor corridor micro-environment may be drastically changed.
CUC-5, CUC-6	B/M	. Interceptor corridor may create pressure/stress to marshland area at east end of Provo Bay. . Same as CUC-3, CUC-4.
CUC-7, CUC-8, CUC-9	B/M	. Same as CUC-5, CUC-6. . Commits Utah Lake to assimilate direct effluent discharge. . Outfall may disrupt shoreline marshland. . Outfall may disturb archaeological sites.

TABLE V-7 (Continued)

DIRECT ECOSYSTEM IMPACTS

Alternative	Localized[1] Impact	Comments
CENTRAL UTAH COUNTY (Con't)		
CUC-10	B/L	. Same as CUC-7, CUC-8, CUC-9. . Commits long interceptor corridor to sewerage works, thus increasing potential area of natural environment to be impacted.
CUC-11, CUC-12	B/L	. Same as CUC-10. . Commits Provo Bay to assimilate direct discharge of effluent. . May disrupt Provo Bay ecosystem dynamics. . May disrupt marshland adjacent to Provo Bay.
CUC-Rec. Plan	B/M	. Same as CUC-5, CUV-6, CUC-3, CUC-4.
WASATCH COUNTY		
WC-1	A	
WC-2	B	. Commits Provo River to assimilate direct effluent discharge. . Outfall may disrupt stream bank communities. . Commits grass-sagebrush habitats to outfall corridor.
WC-3, WC-5	C/M	. Same as WC-2. . Disrupts Provo River stream bank habitat with river crossing. . New facility commits land to life of facility.
WC-4	C/M	. Same as WC-3, WC-5 without Provo River impacts.
WC-6	B/L	. Commits large amounts of natural environment to interceptor corridor. . Impact to aesthetics of Provo Canyon great, especially during construction. . Requires two river crossings - streambank and stream may be disrupted. . Large area of grass-sagebrush habitat committed.
WC-Rec. Plan	C/M	. Same as WC-4.

TABLE V-7 (Continued)

DIRECT ECOSYSTEM IMPACTS

[1] Key:

A - modification and expansion of existing treatment facilities will tend to impact a very small sphere of influence surrounding the facility. Such construction will induce localized short-term impacts, but long-term impacts would be minimal. The natural environment adjacent to existing facilities has undergone and adjusted to the stresses of construction and operation of the existing plant.

B - the next level of ecosystem impact results from those treatment alternatives which include the upgrading and expansion of existing facilities and the construction of new outfall lines or the consolidation of facilities with associate interceptor construction. In addition to the short-term localized impacts described in "A," there is the potential for severe short and long-term impacts resulting from construction of outfalls, interceptors, and/or expanded regional plants. In most cases, new outfalls will cross virgin land, disrupting natural habitat during construction, and possibly permanently altering the pre-construction habitat. Major interceptor corridors will adversely affect terrestrial ecosystems during construction, particularly in undeveloped areas, and may have a long-term impact resulting from the elimination of natural intolerant vegetal communities and the introduction of undesirable, tolerant, weedy vegetation. Regional facilities will require more land, thereby increasing the probability of ecosystem disruption.

C - if consolidation occurs and new regional treatment facilities are constructed, possibly with long outfalls, localized terrestrial ecosystem impacts are likely to be more severe. Under these alternatives, the greatest amount of new land is being committed to sewage works and, thus, is removed from the natural terrestrial habitat.

S - smaller land commitment, short connecting distances, potential adverse impacts are low.

M - moderate land commitment and connecting distances, potential adverse impacts are moderate.

L - large land commitment and connecting distances, potential adverse impacts are great.

TABLE V-8

INDIRECT TERRESTRIAL ECOSYSTEM IMPACTS

Alternative	Ecosystem Impacted	Comments
DAVIS COUNTY		
DC-1, DC-2, DC-3, DC-4	. Great Salt Lake Desert . Grass-Sagebrush . Jordan River Riparian	. Development pressure may tend to be isolated around existing urban centers. . Impacts to ecosystem may be less since surrounding habitats have been exposed to previous development. . Surrounding habitats could be disrupted greatest. . Impact may only be obvious where natural environment is eliminated.
DC-5, DC-6	. Great Salt Lake Desert . Grass-Sagebrush	. Development along interceptor could disrupt aesthetic and environmental quality of Great Salt Lake marshland. . Development could tend to be concentrated along interceptor line, reducing pressures in other areas. . Habitats along interceptor could exhibit a "squeezing out" with pressures increasing in center area (the last hold out). . Development could disrupt migratory routes of wildlife from Wasatch Front to Great Salt Lake - seasonal and daily and around shoreline.
DC-7, DC-8	. Great Salt Lake Desert . Jordan River Riparian . Grass-Sagebrush . Agricultural	. Development may disrupt recreational use of Great Salt Lake marshland due to interceptor induced growth (i.e., gun clubs). . Reduction of native environments used by wildlife migrating from agricultural land. . Disruption of local wildlife migratory routes. . Development could "drive off" marshland wildlife. . Development may eliminate habitats because of the introduction of toxics.

TABLE V-8 (Continued)

INDIRECT TERRESTRIAL ECOSYSTEM IMPACTS

Alternative	Ecosystem Impacted	Comments
DAVIS COUNTY (Con't)		
DC-9	. Great Salt Lake Desert . Jordan River-Riparian . Grass-Sagebrush . Agricultural	. Development should not occur on Farmington Bay Bird Refuge. . Development could cluster around Farmington Bird Refuge thus increasing stress on diverse wildlife populations. . Disruption of migratory routes is possible. . Encroachment onto riparian habitats due to "bunch" development at South Davis South. . Impacts from non-point sources could change. . Intolerant species may be forced out.
DC-10, DC-11	. Jordan River-Riparian . Grass-Sagebrush . Agricultural	. Disruption of migratory routes from Jordan River streambanks to agricultural - grass-sagebrush. . Limited sprawl development along interceptor thus limited habitat impact due to interceptor. . Development may be more urban center oriented, places stress on perimeter habitats.
DC-12, DC-13	. Jordan River-Riparian . Grass-Sagebrush . Agricultural . Great Salt Lake Desert	. Cumulative of DC-7, DC-8, DC-10, DC-11. . Regional system could support higher densities thus increasing degree and number of habitats impacted.
DC-Rec. Plan	. Great Salt Lake Desert . Jordan River-Riparian . Grass-Sagebrush . Agricultural	. Same as DC-7, DC-8.

TABLE V-8 (Continued)

INDIRECT TERRESTRIAL ECOSYSTEM IMPACTS

Alternative	Ecosystem Impacted	Comments
SALT LAKE COUNTY		
SLC-1, SLC-2, SLC-3, SLC-4, SLC-5, SLC-9, SLC-12	. Jordan River-Riparian . Grass-Sagebrush . Agricultural	. Development may impact only perimeter habitats. . Expansion of urban areas may eliminate streambank communities, stressing them to more urban tolerant species. . Communities west of SLC metropolitan area could impact communities which buffer agricultural habitat.
SLC-6, SLC-7, SLC-8, SLC-10 SLC-11	. Jordan River-Riparian . Grass-Sagebrush . Agricultural	. Same as above. . Eliminate or disrupt habitats now separating urban areas south of SLC. . Disrupt migratory routes from Wasatch Front to Jordan River.
SLC-Rec. Plan		. Same as above.
NORTHERN UTAH COUNTY		
NUC-1, NUC-2, NUC-3, NUC-4	. Grass-Sagebrush . Agricultural . Utah Lake-shoreline	. Greatest impacts to surrounding habitats. . Development of agricultural land may limit available agricultural habitat. . Development toward bodies of water will increase stress which would result in removal of particular species and habitats. . Increase pressure to upland game near urban areas.
NUC-5, NUC-6, NUC-7	. Grass-Sagebrush . Agricultural . Utah Lake-shoreline	. Reduces agricultural - grass-sagebrush habitat. . Disruption of migratory routes to Utah Lake from north. . May tend to concentrate development along interceptor, reduces stress on other habitats. . Could increase and change character of non-point pollution to a degree that other impacts are created.

TABLE V-8 (Continued)

INDIRECT TERRESTRIAL ECOSYSTEM IMPACTS

Alternative	Ecosystem Impacted	Comments
NORTHERN UTAH COUNTY (Con't)		. Could lead to displacement of wildlife creating population pressures in other habitats around Utah Lake.
NUC-8, NUC-9	. Grass-Sagebrush . Utah Lake-shoreline . Agricultural	. May disrupt migratory routes. . Could create sprawl along interceptor thus reducing or eliminating large areas of habitat. . Create increases and variations in non-point pollutants. . Reduce aesthetics of Utah Lake and Wasatch Mountains. . Concentrated development could create stress sufficient to drive wildlife to other areas and/or increase wildlife densities thus producing internal stress.
NUC-10, NUC-11, NUC-12	. Grass-Sagebrush . Utah Lake - shoreline . Utah Lake - Provo Bay . Agricultural . Provo River-Riparian	. Same as NUC-8, NUC-9. . Development along Provo River could disrupt streambank habitats. . Development near Provo Bay could disrupt diverse ecosystem.
NUC-Rec. Plan	. Grass-Sagebrush . Agriculture . Utah Lake-shoreline	. Same as NUC-5, NUC-6, NUC-7.
CENTRAL UTAH COUNTY		
CUC-1, CUC-2	. Grass-Sagebrush . Agriculture	. Impact to natural environment probably will be on urban perimeter. . Agricultural habitat may experience minimal impact.

TABLE V-8 (Continued)

INDIRECT TERRESTRIAL ECOSYSTEM IMPACTS

Alternative	Ecosystem Impacted	Comments
CENTRAL UTAH COUNTY (Con't)		
CUC-3, CUC-4	. Grass-Sagebrush . Agricultural	. Same as CUC-1, CUC-2. . Interceptor corridor could direct growth thus increasing development pressure on habitats.
CUC-5, CUC-6, CUC-7	. Grass-Sagebrush . Agricultural . Utah Lake - Provo Bay	. Agricultural habitat could be reduced near Provo Bay disrupting food areas for wildlife. . Disrupt migratory routes to and from Provo Bay on east side. . Increase and change character of non-point pollution to Provo Bay. . Development could disrupt nesting area at east end of Provo Bay. . Concentrated and direct development may reduce stress on other habitats.
CUC-8, CUC-9	. Grass-Sagebrush . Agricultural . Utah Lake - Provo Bay	. Same as CUC-5, CUC-6, CUC-7. . Agricultural habitats may not be as greatly disrupted.
CUC-10, CUC-11, CUC-12	. Grass-Sagebrush . Agricultural . Utah Lake - Provo Bay	. Potential for disruption of migratory routes. . May increase pressure on Provo Bay so that nesting is disrupted and intolerant species removed. . Increase and change in non-point pollution could alter Provo Bay dynamics. . May reduce agriculture habitats and feed/cover areas.
CUC-Rec. Plan	. Grass-Sagebrush . Agriculture . Utah Lake - Provo Bay	. Encouraged growth along interceptors would encourage open space thus contributing aesthetic value. . All impact to Provo Bay mentioned previously. . Reduction in agricultural habitat possible.

TABLE V-8 (Continued)

INDIRECT TERRESTRIAL ECOSYSTEM IMPACTS

Alternative	Ecosystem Impacted	Comments
WASATCH COUNTY		
WC-1, WC-2	. Grass-Sagebrush	. Major impacts may be restricted to perimeter habitats.
WC-3, WC-4, WC-5	. Grass-Sagebrush . Provo River-Riparian	. Corridor development may disrupt habitats. . Disruption of stream bank possible. . Migratory routes may be disrupted. . Non-point pollution may increase and change.
WC-6	. Grass-Sagebrush . Provo River-Riparian . Provo River-Canyon	. Disruption to Provo River streambanks. . Disruption of canyon habitats including nesting area. . Disruption of migratory routes verticle in canyon. . Increase and change in non-point pollution may reduce Provo River value as high quality fishery. . Aesthetics of canyon may be reduced.
WC-Rec. Plan	. Grass-Sagebrush . Provo River-Riparian	. Same as WC-4.

A majority of the land between urban centers is within the grass-sagebrush ecosystem but is being utilized for agriculture. This has created large acreages of unique habitat types which in particular situations has resulted in a more favorable habitat for particular species of wildlife. Grain fields provide food and cover for particular upland game species and small mammals. Orchards provide food, cover, and nesting areas for several forms of "aesthetic" wildlife (i.e., song birds, game birds, etc.). Disruption of these habitats through agricultural practices has generated stresses on the wildlife, yet over years of continued cyclic cultivation many species have adapted and new species have been encouraged.

Development of agricultural lands will not necessarily result in elimination or disruption of particularly unique vegetation associations, but the elimination of tilled acreage and a commitment of it to development will place increased pressure on the wildlife that is dependent upon the man-influenced habitat.

Development will likely disrupt existing known archaeological sites and possibly uncover new ones. To preserve existing known sites, land use management should be implemented which will guarantee their preservation.

ECONOMIC IMPACT

Because all alternative wastewater management strategies were based on the same future land use projection, no differences in induced employment can be assessed. Suffice it to say that any plan alternative will accommodate employment projections as presented in the Plan.

In addition to future employment projections, the Plan alternatives will generate some construction and related employment. To illustrate, the recommended plan will account for $77.5 million in capital investment for construction of sewage works. Assuming that 40 percent of this investment is labor, $31 million of total salary would be generated over the 20 year planning period or $1.55 million per year. At $15,000 per man-year for a construction worker, this would be a little over 100 construction jobs supported annually by projects evolving from the recommended plan. These jobs represent 0.8 percent of the total construction labor force in the Study Area in 1971. Assuming two service related jobs for each construction job, the annual service labor force would have 200 employees (0.3 percent of 1971 employees) supported by the activities related to plan implementation. Neither of these two employment categories are deemed to be significantly impacted by plan implementation. Other employment categories stimulated by implementation of the plan, but not considered above are: treatment plant operating personnel, employees associated with infiltration/inflow correction, and service employees related to these two categories. These categories are also deemed to result in no major impacts on Study Area employment.

There may be significant economic losses due to the development of agricultural land. In 1969, the total market value of Study Area agricultural products sold was $54.5 M. Due to a forecasted net loss of 32,114 acres of agricultural land by 1995, the reduced sale of agricultural products is estimated to cost $6.5 M by 1995 or 12 percent of 1969 levels. It should be noted that this loss could be offset by increases in other market sectors.

FINANCIAL IMPACT

Financial impacts of the wastewater treatment alternatives include the impact on each jurisdiction's capacity to issue bonds to finance construction. Bonding capacity to finance capital improvements such as construction of wastewater treatment facilities is dependent upon a jurisdiction's assessed value which determines the maximum legal limit and the outstanding indebtedness, which, in turn, determines the remaining bonding capacity. The 1973 remaining bonding capacity for each major service area, and the capital cost of the most expensive alternative, the recommended plan, and the recommended plan with secondary treatment are presented in Table V-9. Capital costs for the local service area assuming 75 percent Federal funding through the EPA wastewater treatment facilities grants are also presented in Table V-9. If the most expensive alternatives were implemented, only Northern Utah County would have sufficient remaining bonding capacity, $16.58 M, for projects totalling $14.91 M. If 75 percent Federal funding were used, all areas would have sufficient remaining bonding capacity even with implementation of the most costly treatment alternatives. If the recommended plan were implemented, Davis County and Central Utah County would need Federal funding in order not to exceed the local bonding capacity for construction costs. Central Utah County would still need Federal funds, even if the recommended plan with secondary treatment was implemented.

The recommended plan at secondary treatment in Wasatch County presents a unique situation. In deriving the required capital cost, infiltration/inflow control was assumed but not included in construction costs. The assumed level of infiltration/inflow control was such that even with population growth, the Midway and Heber treatment facilities will have sufficient capacities. Additionally, with secondary treatment at these two facilities, there is no need for a new facility at Charleston at secondary treatment, thus total capital cost in Wasatch County for the recommended plan with secondary treatment is presented as zero in Table V-9. However, it should be noted that the cost of infiltration/inflow control could be significant.

It should be noted that as existing debts are paid off and new growth occurs the remaining bonding capacities as presented in Table V-9 are likely to increase. Additionally, all projects would not be built at once, therefore only a portion of the bonding capacity would be used and a portion paid off before further issues would occur.

The data in this Table can be used to assess the potential impact of constructing wastewater treatment facilities in each major service area but cannot be used to assess financial impacts for any individual jurisdiction contemplating construction. Notwithstanding the above area-wide conclusions, individual jurisdictions may realize more or less impact.

TABLE V-9

1973 BONDING CAPACITY AND CAPITAL COSTS OF WASTEWATER TREATMENT

		1975 Capital Costs					
Service Area	1973 Bonding Capacity ($\$10^6$)	Highest Cost ($\$10^6$)		Recommended Plan ($\$10^6$)		Recommended Plan at Secondary Treatment ($\$10^6$)	
Davis County	10.095	23.77	a)(5.94)	10.35	a)(2.59)	3.22	a)(0.81)
Salt Lake County	43.484	82.73	(20.68)	38.72	(9.68)	22.72	(5.68)
Northern Utah County	16.584	14.91	(3.73)	8.61	(2.15)	5.31	(1.33)
Central Utah County	16.678	29.64	(7.41)	19.39	(4.85)	18.95	(4.74)
Wasatch County	1.983	b)4.65	(1.16)	0.95	(0.24)	c)0	(0)

a)Local capital cost with 75 percent Federal funding.

b)Includes only the cost of the interceptor to Provo.

c)Does not include cost of infiltration control and assumes controls would be such that, even with population growth, existing treatment plant capacities would be sufficient.

SOCIAL IMPACTS

It is rather difficult to pinpoint any changes which may occur in the social characteristics, attitudes, activities, or life styles of Study Area residents as a result of wastewater treatment alternatives. Any set of alternatives by itself is not going to upgrade water quality to such a level that new recreational activities would be available (increased trout fishing or increased body contact water sports). More appropriately, the alternatives will help maintain the current status of these activities. The exception to this situation is in Provo Canyon. If the Provo Canyon interceptor is constructed, the Canyon may experience extreme recreational pressure as a result of residential, commercial, and recreational development. Any changes in life style, if they occur, will result from population growth or land use changes. Land use conversion from agriculture to residential and commercial activities resulting from interceptor locations may influence life styles in the areas of new development, but it is difficult to say what these changes might be.

If some approach to water quality management was not implemented, a noticeable deterioration in water quality could be expected. In this event, some life style changes could result. For example, Utah Lake and Jordan River are both used for recreational activities. A deteriorated water quality would have a possible impact on the continuation of these activities and the demand for other recreational activities would increase This may require increased spending for local parks and recreational facilities, or an increase use of mountain recreation sites. This could also result in higher recreational costs for many families who cannot afford to travel greater distances to other recreation sites.

It is possible that the Plan could have an impact on residents and their activities in those instances where sewer plant expansions occur in proximity to residential areas. Increased odor could curtail outdoor activities or reduce one's satisfaction with their neighborhood. This could result in more moves by nearby residents, or the change from an area occupied by owners to an area occupied by renters. Or, it may eventually result in pressures to change the land use to some nonresidential category.

CHAPTER VI

AIR QUALITY IMPACTS

INTRODUCTION

In order to evaluate the impact on air quality of land use plans associated with or influenced by the wastewater treatment alternatives developed in the Plan, it is necessary to make air quality projections into the future by using air pollution dispersion models. A variety of models are available which employ mathematical formulations to describe the physical air quality system. These models utilize topographic and meteorologic data as input to predict the fate of air pollutants emitted by a variety of sources. Because of the large quantities of input data and the numerous calculations which must be made, most available air quality models are best executed by modern computers.

Once a model is selected and adapted to a particular air basin its input data, for a time period for which monitored data are available, are inserted and air pollution concentrations are calculated for that period. These values are compared with the monitored data to assess the reliability of the model to make predictions. If agreement between calculated and observed concentrations is good, the model may be accepted as reliable to predict future air quality.

Future land use projections are then translated into air pollution source data and inserted into the model. The model then is used to calculate (predict) future concentrations of air pollution in a basin. Comparison of these predicted concentrations with standards allows a determination of the expected impact on air quality of future land use plans.

The following section of this Chapter contains a brief summary of the model used to evaluate the air quality impacts of the Plan, the required input data, and the model verification using existing monitoring data. The details of this information base are presented in Volume B-1000, "Air Quality Modelling," of the Study Task Report Series. Subsequent sections of this Chapter contain the results of air quality impacts resulting from the land use plan associated with the various wastewater treatment alternatives presented in the Plan.

DESCRIPTION OF MODEL

Selection of Model

The choice of atmospheric pollutants to be studied, carbon monoxide (CO) and total suspended particulate (TSP), influenced the choice of dispersion models. Selection of carbon monoxide meant that particular attention would have to be given to line and area source (automotive) emissions, and that one hour and eight hour concentrations would have to be predicted. Particulates are emitted by line, point, and area sources, thus the model should be able to utilize all types of pollutant sources. TSP concentrations are to be predicted for 24 hours and annual averages, and are assumed not to be chemically reactive in significant

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amounts over periods of exposure of interest. Because highly reactive pollutants were excluded from this Study, steady-state nonreactive pollutant models could be employed. Additionally, inversions frequently occur in the Study Area, thus models employed should contain some procedure for accounting for the height of mixing layers limited by inversions.

Several considerations influenced the selection of a combined modelling approach, whereby both CO and TSP would be modelled on a short term (1-hour, 8-hours) and annual average basis and the approach which best matched observed data would be used to evaluate future air quality impacts.

First, it was assumed that the "worst-case" 24-hour period for CO would also serve as the representative period for TSP. It was recognized that worst conditions for CO probably include low wind speeds, while "worst conditions" for TSP may include high wind speeds and dust storms. These conditions of high particulate loading were observed in the monitored data and were attributed to fugitive dust from open fields during non-growing seasons when wind speeds were high. These situations also would tend to occur in the future almost independently of regional growth and water quality plans. They would be affected to some degree, of course, because growth would tend to eliminate some fugitive dust sources, e.g., by building residential areas on present farm lands, although, in this example, some fugitive dust could be generated through construction and sanding of more roads. However, emphasis was placed on determining worst conditions for man-made rather than fugitive particulates, thus the assumption that those conditions associated with CO were also suitable for TSP. The reader should recognize that the 24-hour TSP concentrations calculated using these assumed "worst case" conditions are not directly comparable to the EPA 24-hour standards. However, the TSP predictions under these assumed meteorological conditions will provide a good estimate of the future trends in ambient particulate concentrations.

Second, the lack of a suitable existing model for the Study Area meant that model development would be necessary, and that a complete and consistent data base would have to be assembled. Because no single model with the required capability (i.e., short and long-term calculations for line, area, and point sources) was available, it became necessary to adapt other models to the Utah situation. These models hereinafter designated UTAIR, represent steady state, non-reacting pollutant conditions. The model used for the short term calculations is the RAM model (150) developed by EPA while the annual average model is an adaptation of models used elsewhere for evaluating air quality impacts of future land use plans.

Both the short-term and long-term models operate from the same emission source data base. For the short-term model, hourly meteorological data for particular days were used. For the long-term and 24-hour model, frequency distributions of meteorological data were used for either a full particular day or an average year.

In the short-term model, for each case calculated, no background concentrations of CO were added, but for TSP a background concentration of 20 ug/m^3 (141) was added to all calculated concentrations.

Grid System

Most air quality models, including the UTAIR system, utilize a grid network to locate emission sources and predicted air quality concentrations. The grid network used with the UTAIR system is comprised of two mile square grids for the Salt Lake Air Basin as illustrated in Figure VI-1 and 1.5 mile square grids for the Provo Air Basin as illustrated in Figure VI-2. Receptors, or locations of predicted pollutant concentrations, are located at grid intersections. Special receptors were located at the existing air quality monitoring stations discussed in Chapter II. Calculation for future pollutant concentrations were made at a total of 226 receptor locations in the Salt Lake City basin and at 327 receptor locations in the Provo basin. From these calculated values isopleths showing equal concentration contours were drawn.

DATA BASE FOR MODEL APPLICATION

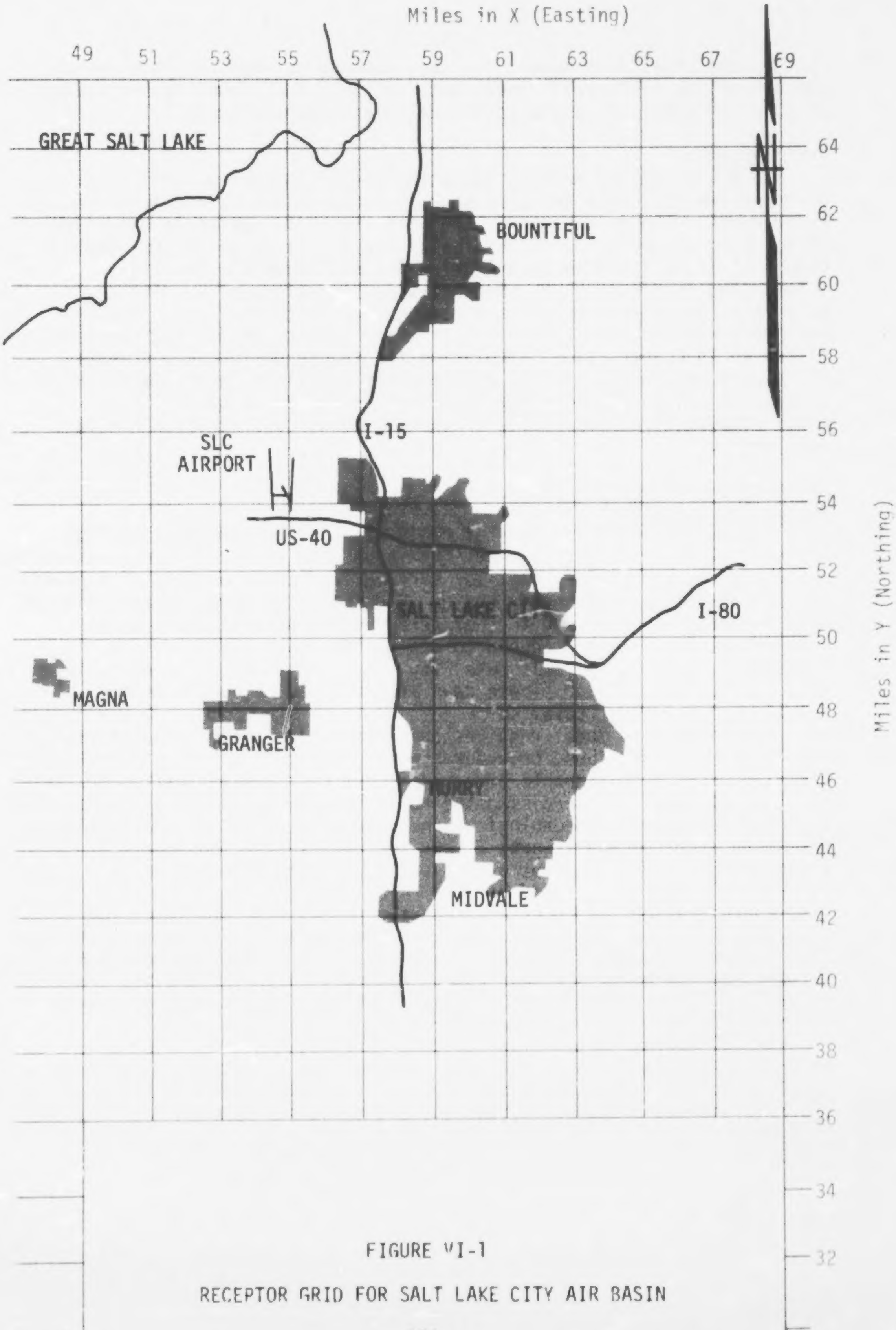
Meteorological Data

The short-term model mode of UTAIR was used to determine maximum one hour average concentrations. The input data were selected by examining the monitored air quality data for 1974 to find those periods of highest CO concentrations in each air basin. Eight days of high concentrations were selected. These were further screened for unusual or atypical occurrences and finally reduced to one day for each basin, Monday, December 2, 1974 in the Salt Lake City basin and Tuesday, November 12, 1974 in the Provo basin. These days are referred to herein as the "worst day" or "worst case."

The short-term model requires considerable computer time for each hourly calculation; thus, procedures were developed to reduce computing time and costs to reasonable amounts without sacrificing realism in the results. Instead of exercising the model for 24 hourly calculations each with different meteorological and source data, the one "worst day" data were examined and a worst 8-hour period was selected from it. Pertinent data for the worst 8-hour period in each selected day are presented in Tables VI-1 and VI-2.

Concentrations of CO at all receptor points were predicted for each hour of the eight hour periods, and concentrations predicted for each hour were averaged over all receptors. The highest average was selected as the worst one hour case. For each basin these times are shown with an asterisk in Tables VI-1 and VI-2. The particular conditions for these two one-hour periods are shown in Table VI-3.

Annual average meteorological data were obtained from the U. S. National Climatic Center. This was supplemented by data obtained from local activities and discussions with local meteorologists. Its characteristics, preparation, and use are discussed below.



Miles in X (Easting)
49
51
53
55
57
59
61
63
65
67
69
64
62
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
Miles in Y (Northing)
N
GREAT SALT LAKE
BOUNTIFUL
I-15
SLC
AIRPORT
US-40
SALT LAKE CITY
I-80
MAGNA
GRANGER
MURRY
MIDVALE

FIGURE VI-1

RECEPTOR GRID FOR SALT LAKE CITY AIR BASIN

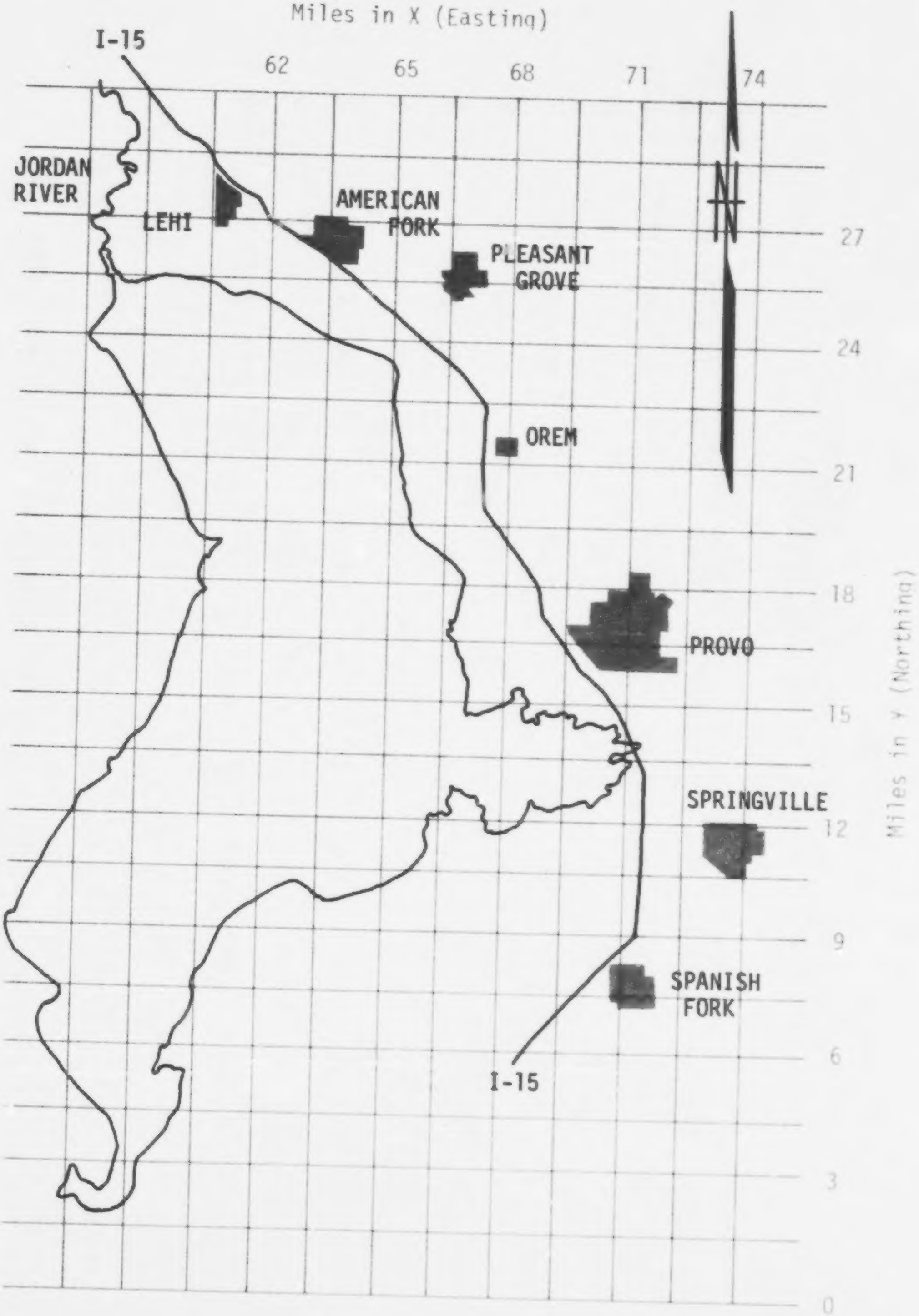

Miles in X (Easting)
I-15
62
65
68
71
74
JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
OREM
PROVO
SPRINGVILLE
SPANISH FORK
I-15
N
27
24
21
18
15
12
9
6
3
0
Miles in Y (Northing)

FIGURE VI-2

RECEPTOR GRID FOR PROVO AIR BASIN

TABLE VI-1

METEOROLOGICAL CONDITIONS FOR THE WORST CASE DAY (DECEMBER 2, 1974) IN THE SALT LAKE CITY BASIN

Time of Day		Temperature	Temperature Difference	Wind Speed		Wind Direction		Mixing Depth	Stability Class	Cloud Cover			Sun Angle Night Slight
Z	MST	T(°F)	T-51°F	knots	m/sec	Degree	Sector	Feet	1-5	%	Type	Height	
14	7	26	-25	4	2.1	140	7	200	5	60	C	M	N
15	8*	24	-27	0	1.5	0	7	200	5	60	C	M	N
16	9	28	-23	5	2.6	160	8	200	4	100	0	M	N
17	10	32	-19	4	2.1	180	9	325	4	100	0	M	S
18	11	36	-15	0	1.5	0	9	550	4	100	0	M	S
19	12	41	-10	0	1.5	0	4	1450	2	20	C	M	S
20	13	45	-6	4	2.1	70	4	1900	3	20	C	H	S
21	14	45	-6	10	5.1	300	14	1900	4	30	C	H	S

LEGEND:

*	-	Worst one hour.
MST	-	Mountain Standard Time.
m/sec	-	meters per second.
Sector	-	22½ degree arcs measured from north, e.g., Sector 1 refers to a wind blowing from the north, Sector 9 is a south wind.
Class	-	Turner's classifications of atmospheric stability: 1 (very unstable), 2 (unstable), 3 (slightly unstable), 4 (neutral), 5 (stable).
Type	-	Amount of cloudiness: C (less than 5/8 cloud cover), B (5/8 to 7/8 cloud cover), or 0 (more than 7/8 of sky obscurred by clouds).
Height	-	mean level of cloud base: L (less than 7,000 feet above ground), M (7,000 to 20,000 feet), or H (over 20,000 feet).
Sun angle	-	N (night-from one hour before sunset to one hour after sunrise), S (sun angle between 15 and 35 degrees from the horizon), M (35 to 60 degrees), or ST (greater than 60 degrees).

TABLE VI-2

METEOROLOGICAL CONDITIONS FOR THE WORST CASE DAY (NOVEMBER 12, 1974) IN THE PROVO BASIN

Time of Day		Temperature	Temperature Difference	Wind Speed		Wind Direction		Mixing Depth	Stability Class	Cloud Cover			Sun Angle
Z	MST	T(°F)	T-51°F	knots	m/sec	Degree	Sector	Feet	1-5	%	Type	Height	Night Slight
24	17*	50	-1	5	2.2		15	2243	4	100	0		N
1	18	45	-6	4	1.8		11	2064	4	90	0		N
2	19	44	-7	3	1.5		5	1886	4	100	0		N
3	20	42	-9	4	1.8		7	1707	4	100	0		N
4	21	41	-10	3	1.5		15	1529	4	100	0		N
5	22	39	-12	2	1.5		1	1350	4	100	0		N
6	23	39	-12	3	1.5		15	1171	4	100	0		N
7	24	38	-13	3	1.5		11	993	4	100	0		N

LEGEND:

* - Worst one hour.
MST - Mountain Standard Time.
m/sec - meters per second.
Sector - 22½ degree arcs measured from north, e.g., Sector 1 refers to a wind blowing from the north, Sector 9 is a south wind.
Class - Turner's classifications of atmospheric stability: 1 (very unstable), 2 (unstable), 3 (slightly unstable), 4 (neutral), 5 (stable).
Type - Amount of cloudiness: C (less than 5/8 cloud cover), B (5/8 to 7/8 cloud cover), or O (more than 7/8 of sky obscurred by clouds).
Height - mean level of cloud base: L (less than 7,000 feet above ground), M (7,000 to 20,000 feet), or H (over 20,000 feet).
Sun Angle - N (night-from one hour before sunset to one hour after sunrise), S (sun angle between 15 and 35 degrees from the horizon), M (35 to 60 degrees), or ST (greater than 60 degrees).

TABLE VI-3

METEOROLOGICAL CONDITIONS FOR WORST HOUR OF WORST DAYS

For each air basin the specific worst one hour conditions are given below.

SALT LAKE CITY BASIN

Day : Monday, December 2, 1974

Time : 0800 hours

Temperature : 24°F.

Temperature difference from annual average : -27°F.

Wind speed : less than 1.5 m/sec (calm)

Wind direction : SE

Inversion Height (mixing depth) : 61m

Cloud cover : 60%, type less than 63% (clear), height 14,000 feet

Sun angle : less than 15°

Stability class : 5 (stable)

PROVO BASIN

Day : Tuesday, November 12, 1974

Time : 1700 hours

Temperature : 50°F

Temperature difference from annual average : - 1°F.

Wind speed : 2.2 m/sec

Wind direction : NW

Inversion Height (mixing depth) : 684m

Cloud cover : 100%, type greater than 88% (overcast), height 25,000 feet

Sun angle : less than 15°

Stability class : 4 (neutral)

Salt Lake City Basin - Annual Average Conditions

Meterological data for the Salt Lake City area was derived from the Salt Lake City Airport weather station. A wind rose, taken from the CHESS study (142) for this station for the period 1951-1960, is presented in Figure VI-3. It is felt that this wind rose is indicative of conditions similar to those used in this Study.

Figure VI-3 illustrates that approximately 50 percent of the winds are from the south to southeast and approximately 25 percent are from the west-northwest to north. These are the predominant winds while the remaining winds occur from all other directions.

The predominant southeast winds with a mean speed of 7 mph are primarily downslope during the nighttime which includes the morning hours. The northwest winds with a mean speed of 9 mph are mostly the afternoon and early evening upslope winds.

Meteorological data from the Salt Lake City Airport were used to formulate annual average conditions of wind direction, wind speed, and atmospheric stability which is a measure of the turbulence that causes dispersion of pollutants. A frequency distribution of the number of times winds of a certain speed would be in certain directions when the atmosphere was in a particular condition of stability was prepared from this analysis and used in the predictive model.

Provo Basin - Annual Average Conditions

Meteorological data similar to that obtained from the Salt Lake City Airport is not available for the Provo Basin. However, Brigham Young University (BYU) has compiled four years of wind data (1963-1966) at a station on campus. These data are illustrated in Figure VI-4. Stability-related data from the Salt Lake City Airport station were used to derive atmospheric stability distributions for the BYU station because such information was not available for the campus station. This precedure adds uncertainty to the model predictions for the air basin, but represents the best use of existing data.

Emission Data

Emission inventories were developed for 1974 and 1995. Three types of emission sources (point, area, and line) were considered. The estimated total annual emissions for carbon monoxide (CO) and total suspended particulates (TSP) for each type of source are presented in Table VI-4 and discussed below:

A. Point sources. Point source data were taken from the ongoing Pacific Environmental Services (PES) study for Utah and from the State of Utah - Department of Social Services, Division of Health files of emission notices. As illustrated in Figures VI-5 and VI-6, 47 point sources were identified in the Salt Lake City basin and 17 sources in the Provo basin. Total emissions from these sources are estimated to remain almost constant between 1974 and 1995.

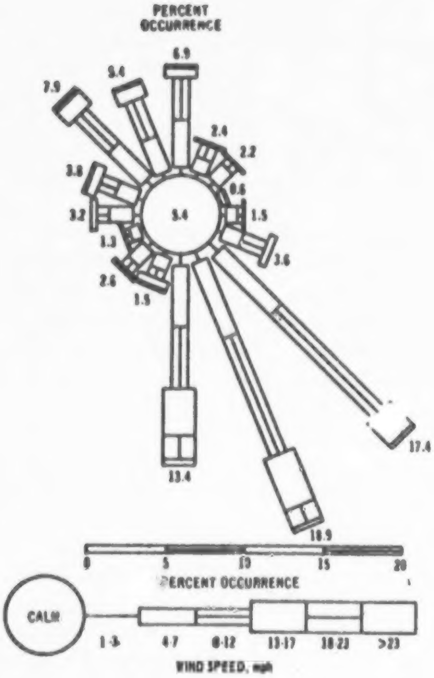


FIGURE VI-3

SURFACE CLIMATOLOGIC WIND ROSE,
SALT LAKE CITY AIRPORT (1951-1960)

FIGURE VI-4

WIND DATA - BRIGHAM YOUNG UNIVERSITY
1953 - 1966

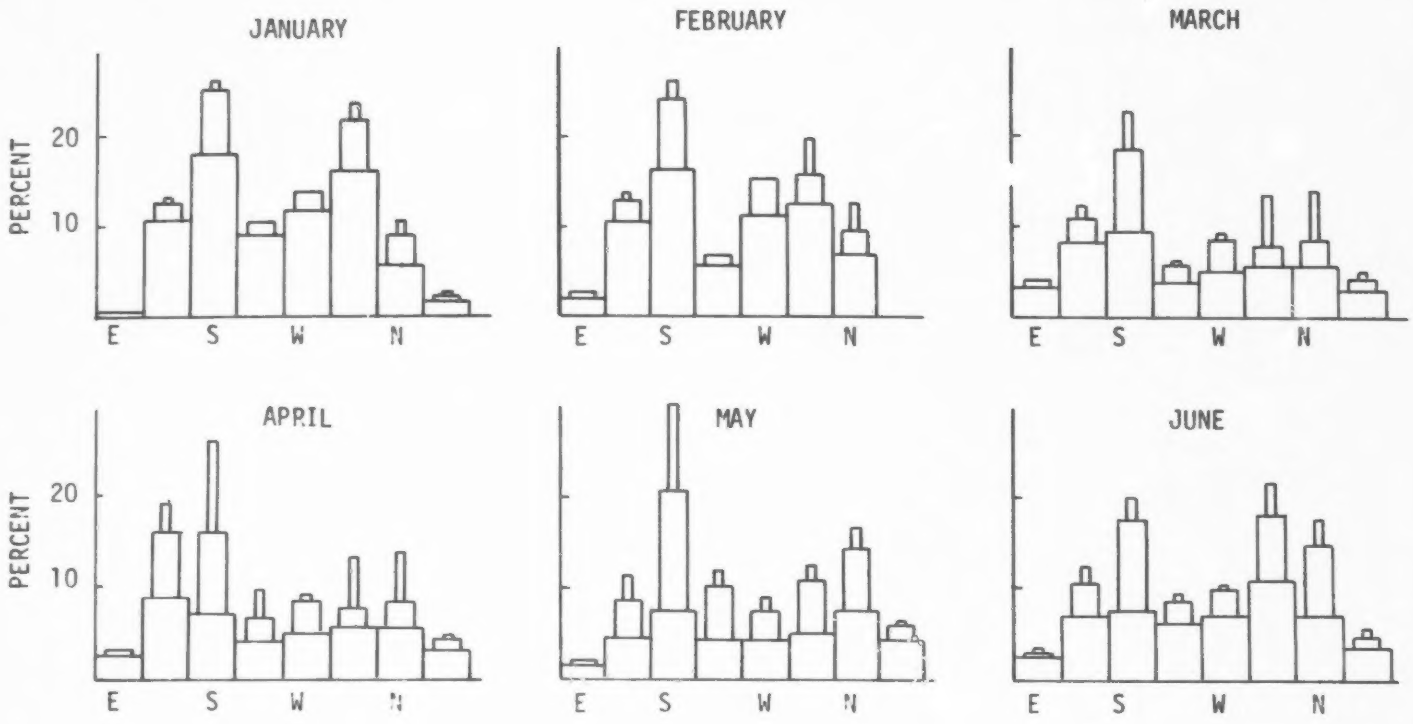


FIGURE VI-4 (Continued)

WIND DATA - BRIGHAM YOUNG UNIVERSITY
1953 - 1966

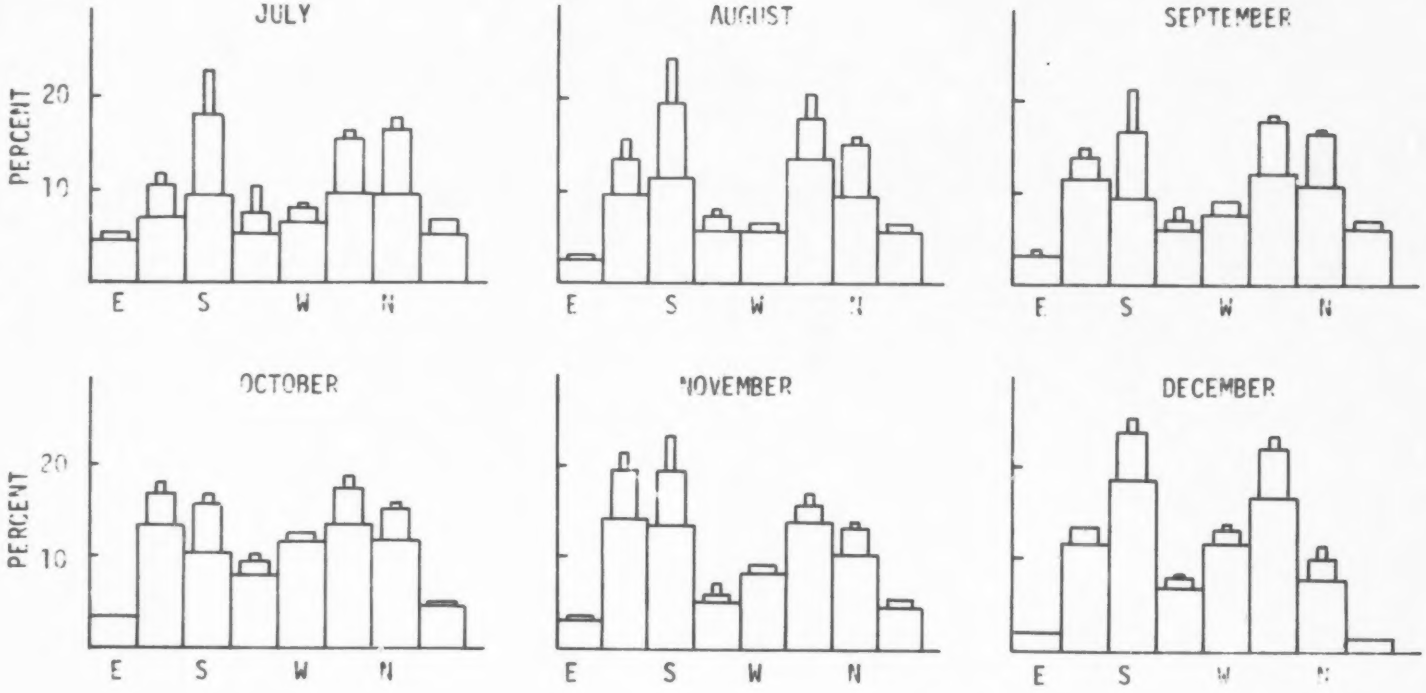
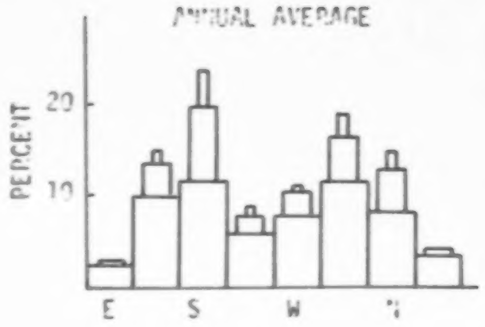


FIGURE VI-4 (Continued)

WIND DATA - BRIGHAM YOUNG UNIVERSITY
1953 - 1966



Key: Ordinate is percentage of time wind blows in given direction. Bottom, middle, and top segments refer to wind speeds between 0-2, 2-4, and >4 knots. Abscissa gives direction from which the wind blows.

Average Wind Speeds (knots)

North

January	2.2	July	3.4
February	2.6	August	3.2
March	4.0	September	2.6
April	4.8	October	2.2
May	4.4	November	2.6
June	3.6	December	2.0
		Year	3.1

TABLE VI-4

ESTIMATED ANNUAL EMISSIONS OF CARBON MONOXIDE AND TOTAL SUSPENDED PARTICULATES IN STUDY AREA

Source	Pollutant	Emissions (tons/year) 1974	Emissions (tons/year) 1995
Point	Carbon Monoxide	26,443	26,192
	Total Suspended Particulates	33,962	33,975
Line	Carbon Monoxide	430,162	102,631
	Total Suspended Particulates	18,672	22,231
Area	Carbon Monoxide	23,432	8,733
	Total Suspended Particulates	18,767	24,730
Total	Carbon Monoxide	480,037	137,556
	Total Suspended Particulates	71,401	80,936

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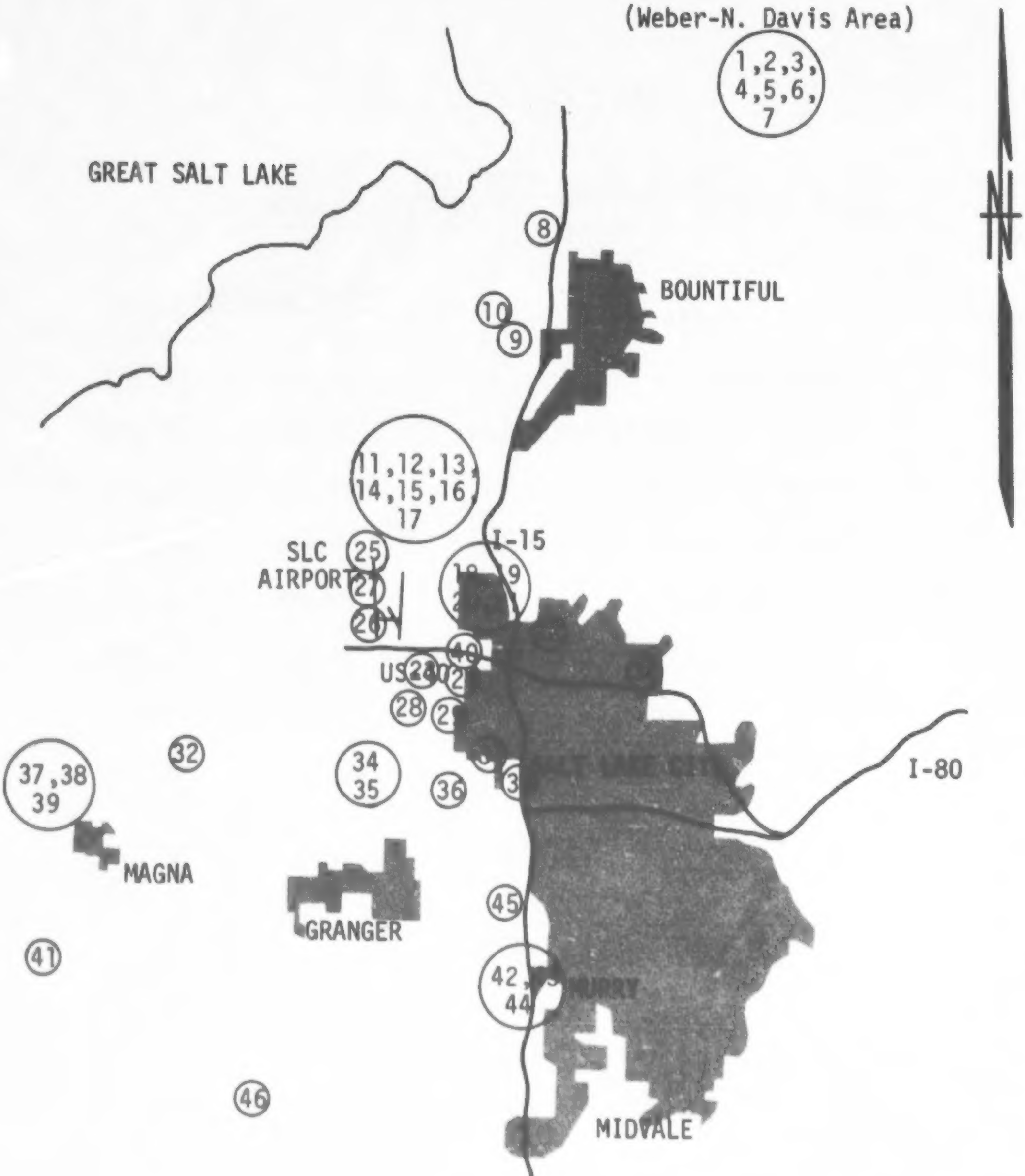

(Weber-N. Davis Area)
1,2,3,
4,5,6,
7
GREAT SALT LAKE
8
BOUNTIFUL
10
9
11,12,13,
14,15,16,
17
SLC
AIRPORT
25
27
26
I-15
40
US
24
28
34
35
36
37,38
39
32
SALT LAKE CITY
I-80
MAGNA
GRANGER
45
41
42,
44
MURRY
46
MIDVALE

(SEE LEGEND NEXT PAGE)

FIGURE VI-5

POINT SOURCES IN SALT LAKE CITY AIR BASIN

FIGURE VI-5 (Continued)

POINT SOURCES IN SALT LAKE CITY AIR BASIN

LEGEND:

1	Interpace
2	Weber Co. Corp.
3	Clearfield Steam Co.
4	Hill AFB
5	Ideal Ready-Mix (Lay)
6	Parson Ready-Mix
7	Ideal Ready-Mix (Og.)
8	Syro Steel
9	Phillips Ref.
10	Davis Ready-Mix
11-13	Husky Ref.
14-16	Chevron Ref.
17	Monroe (Beck St.)
18	Utah S&G
19	Gardner Asph.
20-21	Amoco Ref.
22	LDS Hospital
23	NL Ind.
24	UPL NSLPP
25-27	SLC Airport
28	AMCOR SLC
29	MS Lime
30	Utah University
31	LDS Welf.
32	Gibbons Concrete
33	Portland Cement
34	Filtrol
35	Osteler
36	EIMCO Foundry
37-39	Kennecott
40	May Foundry
41	Hercules
42	Brookfield Prod.
43	Monroe (Murray)
44	Kiewit
45	Wasatch Mt.
46	Monroe (62S)
47	Proler

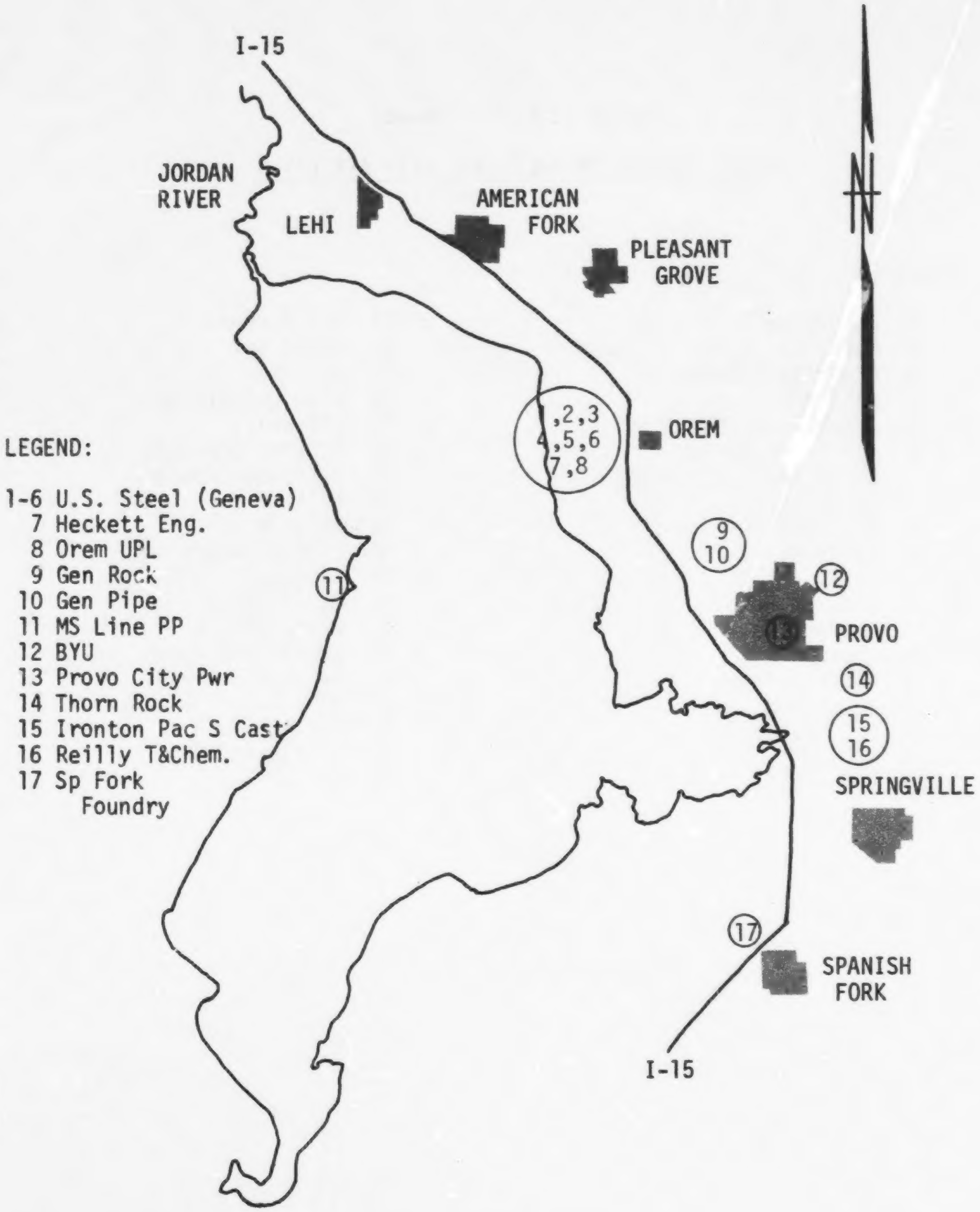

I-15
JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
N
1,2,3
4,5,6
7,8
OREM
LEGEND:
1-6 U.S. Steel (Geneva)
7 Heckett Eng.
8 Orem UPL
9 Gen Rock
10 Gen Pipe
11 MS Line PP
12 BYU
13 Provo City Pwr
14 Thorn Rock
15 Ironton Pac S Cast
16 Reilly T&Chem.
17 Sp Fork Foundry
9
10
11
12
13
PROVO
14
15
16
SPRINGVILLE
17
SPANISH FORK
I-15

FIGURE VI-6

POINT SOURCES IN THE PROVO AIR BASIN

B. Line sources. The line source inventory for the future (1995) time period was furnished by the Utah State Department of Highways. These data were developed as part of the SLATS (143), UVATS (144), and OATS (145) studies. Annual average data from these studies were directly applicable; but some data extrapolation was necessary for the short-term case. Methodology and results of the extrapolation were coordinated with the Highway Department's planners. Line source inventory for the present (1974) time period was also obtained from the Utah State Department of Highways (153, 154). Line source emission estimates for CO were based on the type of automotive vehicle, the year, the recommended vehicle mix, cold starts, Utah's altitude and temperatures, and the range of average driving speeds. Estimating procedures followed EPA guidelines (155) for calculating automotive emission factors. Vehicle emission factors for 1975 and 1995, assuming an annual average temperature of 51°F., are presented in Table VI-5.

C. Area sources. Area source emissions were based upon the projected distributions of population and employment, and upon Utah data regarding fuel consumption. The basic area source input data for the air quality model are presented in Volume B-1000, "Air Quality Modelling," of the Study Task Report Series. For the Salt Lake City air basin, 187 area sources were employed, while the Provo air basin was divided into 48 area sources. Available SIP provisions do not specify reductions in particulate emissions for each individual source. There is evidence of recent reductions in emissions from some sources, but no basis for projecting additional changes resulting from implementation of the SIP.

As the study progressed, it became evident that carbon-monoxide emissions and concentrations can be expected to decrease significantly between 1974 and 1995. Because both one-hour and eight-hour CO standards were exceeded over much of the Study Area in 1974, the rate of reduction in emissions between 1974 and 1995 became a matter of concern. Although it was not possible to assemble a complete emission inventory and perform model runs for the interim time period, it was decided to perform a brief analysis of the expected situation for the year 1985. The 1985 interpolation was restricted primarily to carbon monoxide because, based upon available data, particulate concentrations will not change significantly between 1974 and 1995.

The following process was used to estimate emissions for the one-hour maximum carbon monoxide concentration in 1985. A median population and employment distribution (arithmetic average of the population and employment for 1974 and 1995) was assumed. The meteorological conditions were those used for computing the one-hour maximum concentrations for 1974 and 1995. Linear interpolation was used for point source emissions, which are expected to remain almost constant over the period 1974-1995.

Speeds for various road elements in 1974 were determined from Utah Highway Department data. They were assumed to be the same for 1985.

TABLE VI-5

COMPOSITE LINE SOURCE EMISSION FACTORS FOR CARBON MONOXIDE (CO) IN GRAMS/MILE

Speed (MPH)	Calendar Year 1975	Calendar Year 1995
10	211	21
15	146	15
17	137	14
18	132	13
19	127	12
20	123	12
21	119	11
22	116	11
23	112	11
24	109	11
25	106	10
26	103	10
27	101	10
31	92	9
32	90	8
34	87	8
35	86	7
36	84	7
37	83	7
38	81	7
40	80	7
43	77	7

From these data, the percent of total vehicle miles (TVM) driven at each speed was assumed to be the same in 1985. An annual growth rate of 4 percent through 1980, and an annual growth rate of 2 percent thereafter, was used. This growth rate was applied to 1974 TVM per day to extrapolate to the 1985 TVM. The same growth rates were applied to the 1995 TVM to reduce TVM per day in 1995 to that in 1985. These two values were then averaged to obtain the TVM per day in 1985. The TVM per day in 1985 at each speed was obtained by multiplying the total TVM per day in 1985 by the fractional TVM per day at each speed. The emissions in grams/mile were determined for the two "worst" days listed in Table VI-3 by applying the same method used in calculating the 1974 and 1995 emissions. The resultant CO emission factors are presented in Table VI-6.

The TVM per day and emissions in grams/mile for each speed were used to determine the emissions in grams/second.

A summary of the resulting CO emission is presented in Table VI-7. The area-source emissions include emissions from off-highway automotive traffic, in addition to emissions from space heating. The percentage reduction in the Provo air basin is greater than that predicted for the Salt Lake City air basin. The difference in percentages arises primarily from difference in temperature during the "worst case" one hour period in Salt Lake City and Provo. On an annual-average basis, the percentage reductions for the two basins would be similar, and would approximate those shown for the one-hour case in Provo.

It was assumed that for each type of source (i.e., point, area, and line) concentrations would be proportional to emissions. For each source the ratios of emissions in 1985 to those in 1974 were determined and multiplied into the concentrations at all receptor points for 1974. The ratios of the emissions for 1985 to those in 1995 were also determined and multiplied into the concentrations in 1995 at every receptor point. The concentrations at each receptor formed in both ways were averaged. This gave the final values of one-hour maximum average concentrations at every receptor point in each air basin for 1985.

MODEL VERIFICATION

Although CO and TSP data exist for some or all of the 13 air quality monitoring stations in the Study Area, the availability of line, point, and area source emission inventories for only the urban areas precluded using data from all 13 stations for verification of the model. As a result data from only the Salt Lake City, Salt Lake City Airport, Bountiful, Orem, Geneva, and Provo monitoring stations were used.

The base meteorologic and source data previously discussed was used to model the "worst day" conditions of December 2, 1974 in the Salt Lake City basin and November 12, 1974 in the Provo basin. A comparison of monitored values and calculated data for the maximum 1-hour and 8-hour CO concentrations as well as the 24-hour and annual average TSP concentrations is presented in Table VI-8.

In comparing the modelled CO values with the monitored CO values presented in Table VI-8, relatively good agreement is apparent. The maximum differences occur at the Salt Lake City monitoring site where the model produced maximum 1-hour and 8-hour CO estimates 20 percent higher than observed values. Estimated values at the Bountiful and Provo monitoring sites were only 7 and 13 percent higher than observed

TABLE VI-6

AUTOMOTIVE CO EMISSION FACTORS FOR 1985 IN GRAMS/MILE

Speed in mph	Salt Lake City Basin December 2, 1974 (24°F)	Provo Basin November 12, 1974 (50°F)	Both Basins Annual Average Temperature (51°F)
10	106	52	50
15	72	34	33
17	67	32	30
18	64	31	29
19	62	30	29
20	60	29	28
21	59	28	27
22	56	27	26
23	55	26	25
24	53	25	24
25	52	25	24
26	51	24	23
27	49	23	22
31	45	21	20
32	44	21	20
34	42	20	19
35	41	19	19
36	41	19	18
37	40	19	18
38	39	18	17
40	38	17	16
43	36	17	16

TABLE VI-7

TREND IN MAXIMUM ONE-HOUR CARBON MONOXIDE EMISSIONS (WORST-CASE CONDITIONS)

Air Basin	Type of Source	Emissions (grams/second)		Percent Change
		1974	1985	
Salt Lake City	Line	17,070	8,010	-53
	Point	400	395	- 1
	Area	2,110	1,015	-52
	Total	19,580	9,420	-52
Provo	Line	4,645	1,290	-72
	Point	535	535	0
	Area	565	165	-71
	Total	5,745	1,990	-65

TABLE VI-8

COMPARISON OF CALCULATED WITH MONITORED DATA FOR 1974

Monitoring Station	Carbon Monoxide Comparison (ppm)				Particulate Matter Comparison (ug/m^3)			
	Maximum 1-Hour Concentration		Maximum 8-Hour Concentration		24-Hour Concentration		Annual Average	
	Monitor	Model	Monitor	Model	Monitor	Model	Monitor	Model
Salt Lake City[1]	36	43.3	16.0	19.2	212	257	83	255
Salt Lake City Airport[1]	-	-	-	-	183	147	76	102
Bountiful[1]	23	21.4	9.25	8.57	107	91	49	74
Orem[2]	-	-	-	-	Unavail.	79	65	81
Geneva[2]	-	-	-	-	128	53	64	53
Provo[2]	30	26.1	16.1	14.0	122	132	78	74

Particulate concentrations include an assumed "background" of 20 micrograms per cubic meter, in accordance with Reference 141.

NOTES:

1. Data for December 2, 1974.
2. Data for November 12, 1974.

concentrations of CO. No further comparison of modelled and monitored CO values was made because of the limited number of stations (three) involved.

Because a comparison of calculated and monitored TSP values could be made at six sampling locations, a regression-type analysis was made on this data base. The results of this analysis are illustrated in Figures VI-7 and VI-8 for the 24-hour and average annual TSP concentrations, respectively. The results include monitoring sites in both basins and include a 20 ug/m^3 background TSP concentration for estimated values. Because the intercepts of the equations of "best fit" are not zero and the correlation coefficient for the average annual TSP values is only 0.60, some statistical unreliability is apparent. Additionally, positive intercepts could imply that background TSP concentrations in the Study Area may be greater than 20 ug/m^3. However, in general the "best fit" lines in Figures VI-7 and VI-8 reflect a relatively good comparison between monitored and calculated TSP concentrations.

Although models such as UTAIR tend to predict concentrations rather accurately over a number of sample points in a statistical sense, predicted values at a single sample point often differ significantly from observed readings. For example, in Table VI-8 a predicted annual average of 255 micrograms per cubic meter (ug/m^3) for particulates at the downtown monitoring station, is compared with a monitored value of 83 ug/m^3. Possible causes of the difference include:

1. The model predicts ground level concentrations, whereas the Salt Lake City station is located about 35 feet above ground level (142). Because only about 3 percent of the predicted ambient concentration originates from point sources, and because there is a heavy concentration of essentially ground-level line and area source emissions in the immediate vicinity of the station, predicted concentrations at ground level are likely to be significantly higher than for a receptor height of 35 feet.
2. The meteorological data used by the model were accumulated at the Salt Lake Airport, which is located in relatively open terrain, whereas the downtown Salt Lake City station is unique in that it is located in the heart of a metropolitan area, and has a combination of thermally induced wind circulations, such as the mountain valley, heat island and lake breeze circulations (147). Differences in atmospheric data between the two sites might have a significant effect upon the predicted concentrations.
3. Local microscale conditions (e.g., adjacent parking lots, obstructions, ventilators, wind currents), can have a significant impact upon monitored readings, as can calibration practices and the inherent mean percentage errors of the monitoring equipment.

Thus, in order to resolve discrepancies between monitored data and model predictions, it is necessary to perform an objective evaluation of the model, the inventory, and the monitoring station. In the present

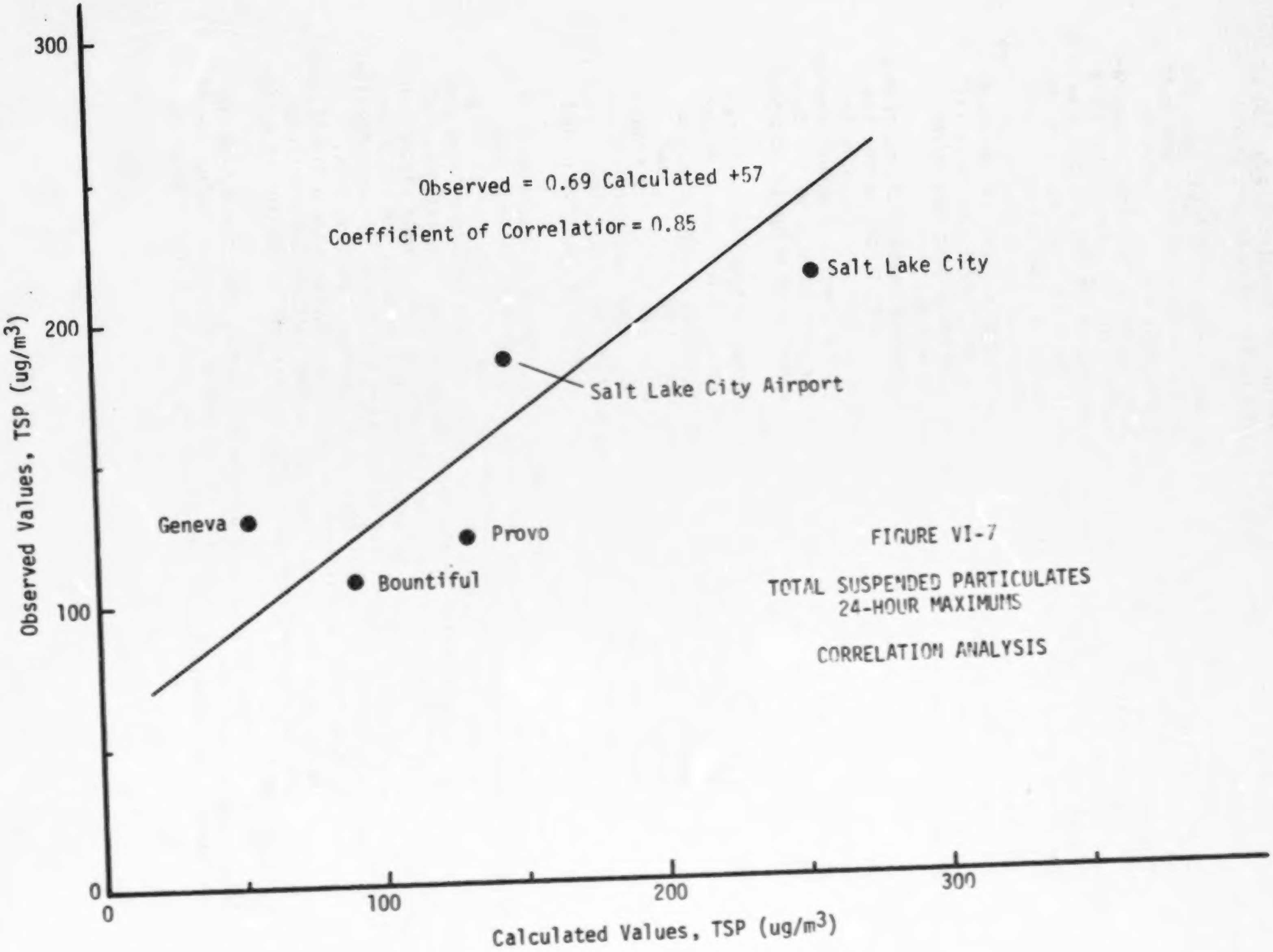


FIGURE VI-7

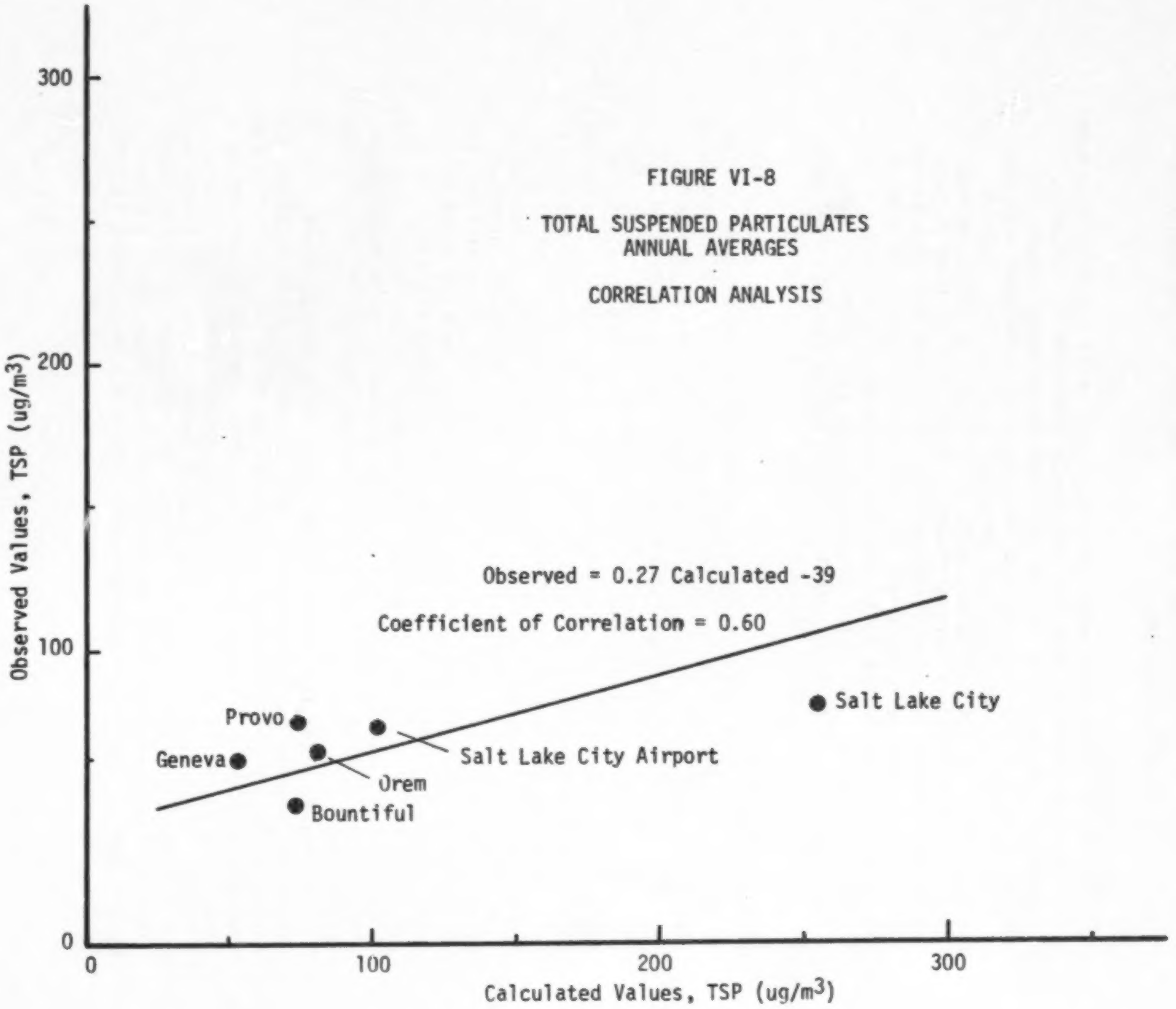
TOTAL SUSPENDED PARTICULATES
24-HOUR MAXIMUMS

CORRELATION ANALYSIS

FIGURE VI-8

TOTAL SUSPENDED PARTICULATES
ANNUAL AVERAGES

CORRELATION ANALYSIS



instance, it is possible to state only that the model's results, as presented in Table VI-8, appear to be in reasonable agreement with most of the output of the monitoring stations, but high in the region surrounding the downtown station.

AIR QUALITY IMPACTS

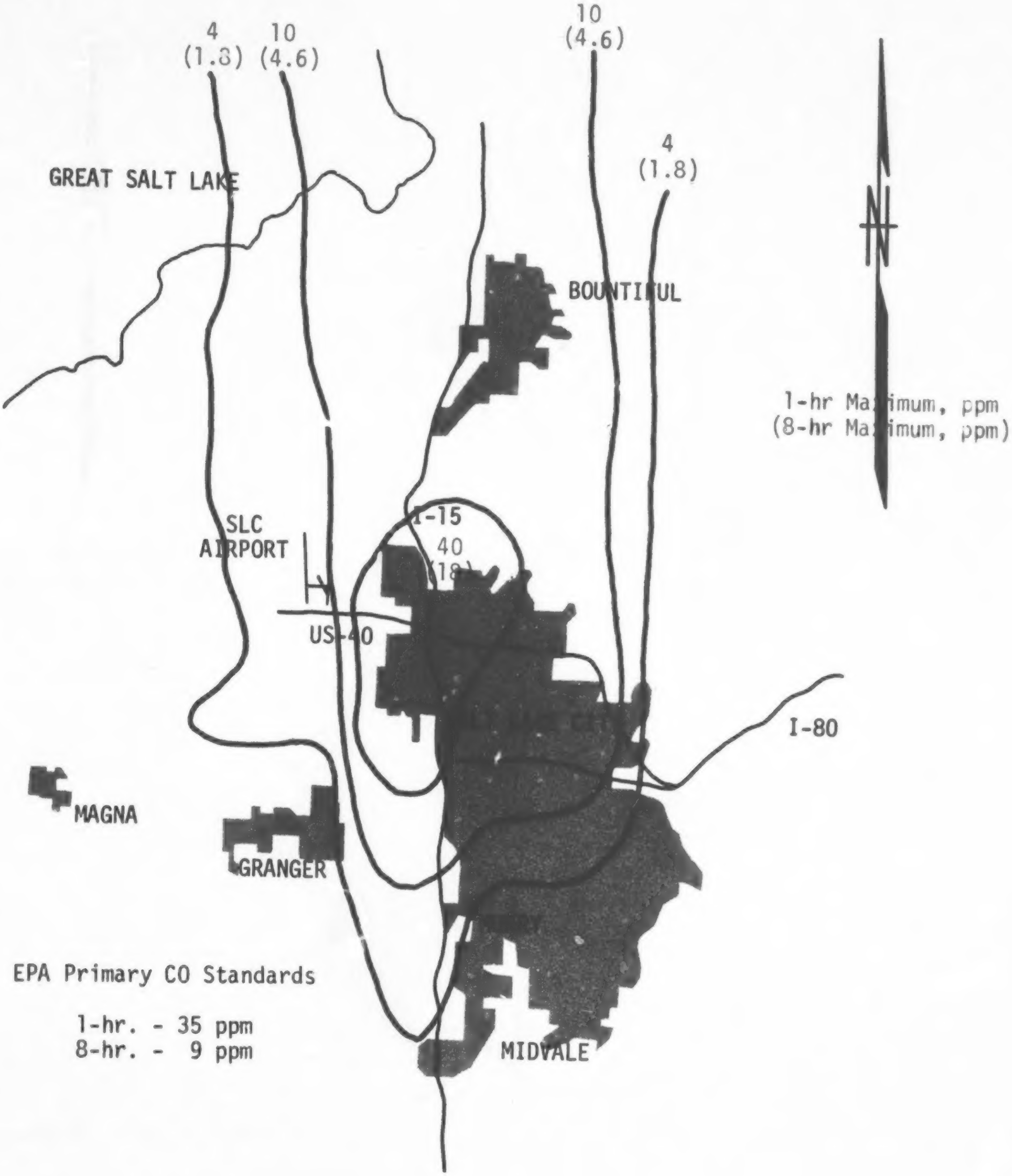
The UTAIR modelling system including both short and long term modes was used in conjunction with the previously described topographic, meteorologic, and emission source data base to estimate future air quality impacts resulting from the land use plan associated with the wastewater treatment alternatives presented in the Plan. Maximum average 1-hour CO concentrations were calculated from which maximum 8-hour CO concentrations were estimated. Additionally, both 24-hour and annual average TSP concentrations were calculated for both basins. These calculations were performed for 1974 and 1995 and were made at 226 receptor sites in the Salt Lake City basin and 327 receptor sites in the Provo basin. Isopleths (lines of equal concentration) were drawn from these calculated values. The following discussion of perceived air quality impacts is based on these isopleths.

Carbon Monoxide

Isopleths for CO concentration for one and 8-hour maximum averages in 1974 and 1995 are illustrated in Figures VI-9 and VI-10 for the Salt Lake City basin and in Figures VI-11 and VI-12 for the Provo basin.

The 1-hour CO isopleths for the Salt Lake City air basin in 1974 and 1995 (Figures VI-9 and VI-10, respectively) reflect a marked improvement in CO concentrations in the future. The 1974 isopleths in Figure VI-9 indicate that, under "worst-case" meteorological conditions, a large region extending to the north and northwest from the Salt Lake City urban center exceeds the 35-ppm 1-hour CO standard. The wind in the defined "worst-case" condition is blowing from the south-southeast. Accordingly, the concentrations are displaced to the north-northwest of the major emission sources. Under some other set of conditions, the pollutant concentration in a given location (e.g., Murray) might be much higher than that shown in the Figure, but should not equal the 40 ppm obtained in Salt Lake City under the defined "worst case." For 1995, neither the one hour or 8-hour standard is estimated to be exceeded in the Salt Lake City air basin under the assumed "worst-case" meteorological conditions.

A similar situation exists in the Provo basin although only the 8-hour CO standard is violated under 1974 conditions illustrated in Figure IV-11. Highest existing concentrations of CO are manifested over southern Provo with 1-hour average CO concentrations of 25 ppm and an 8-hour average of 11 ppm which exceeds the 8-hour standard of 9 ppm. A second "high" is apparent in the area of Geneva Steel with 1-hour maximum average CO concentrations of 10 ppm. By 1995, the estimated 1-hour average CO concentration will be only 5 ppm over Provo and 1 ppm over Geneva Steel. The 8-hour standard also should not be exceeded in 1995.


4
(1.8)
10
(4.6)
10
(4.6)
4
(1.8)
GREAT SALT LAKE
N
BOUNTIFUL
1-hr Maximum, ppm
(8-hr Maximum, ppm)
SLC
AIRPORT
I-15
40
(18)
US-40
I-80
MAGNA
GRANGER
MIDVALE

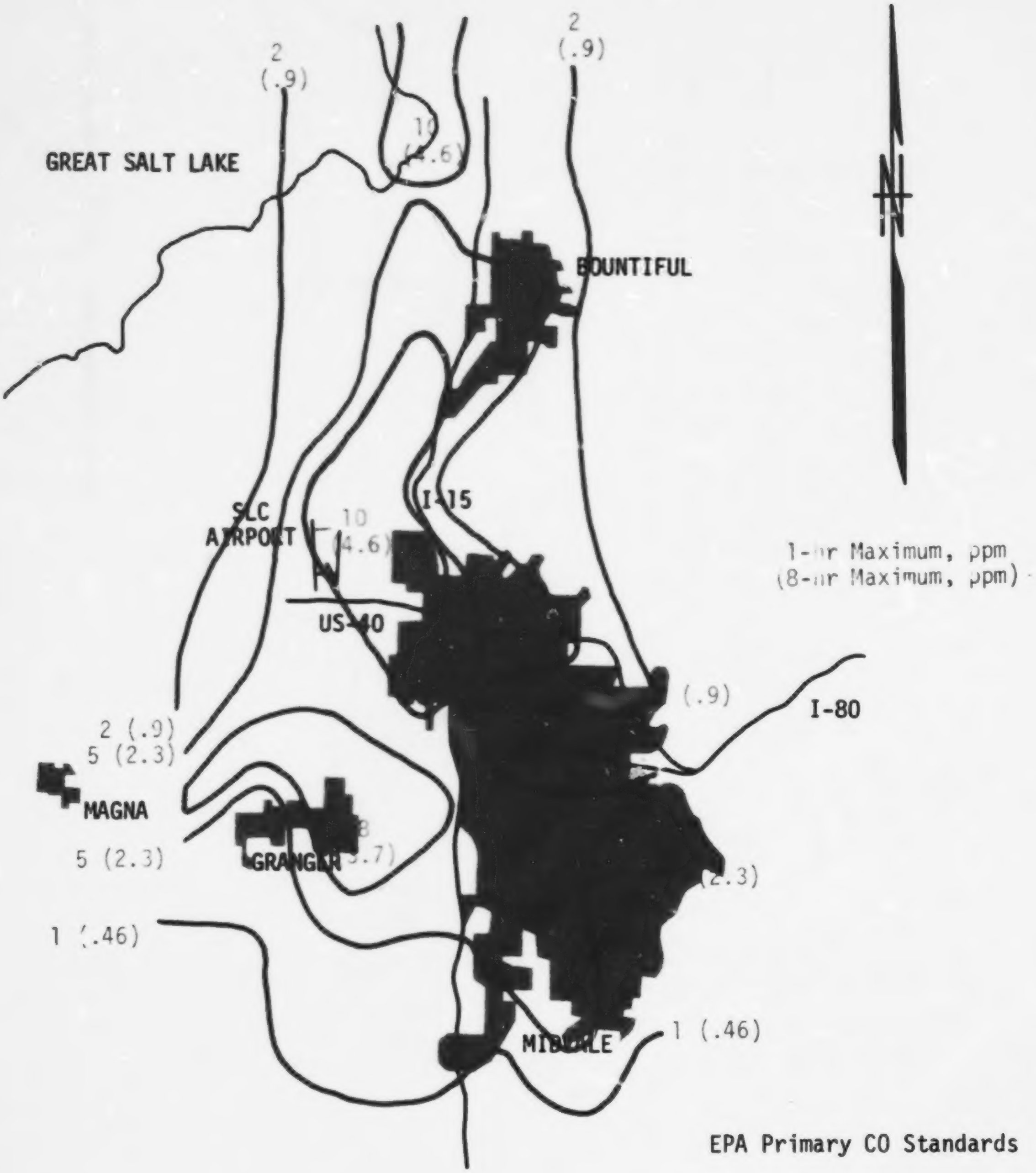
EPA Primary CO Standards

1-hr. - 35 ppm
8-hr. - 9 ppm

FIGURE VI-9

1974 CARBON MONOXIDE CONCENTRATION

SALT LAKE CITY AIR BASIN


2
(.9)
10
(4.6)
2
(.9)
GREAT SALT LAKE
BOUNTIFUL
SLC
AIRPORT
10
(4.6)
I-15
1-hr Maximum, ppm
(8-hr Maximum, ppm)
US-40
(.9)
I-80
2 (.9)
5 (2.3)
MAGNA
8
(3.7)
5 (2.3)
GRANGER
(2.3)
1 (.46)
MIDVALE
1 (.46)
N

EPA Primary CO Standards

1-hr. - 35 ppm
8-hr. - 9 ppm

FIGURE VI-10

1995 CARBON MONOXIDE CONCENTRATION

SALT LAKE CITY AIR BASIN

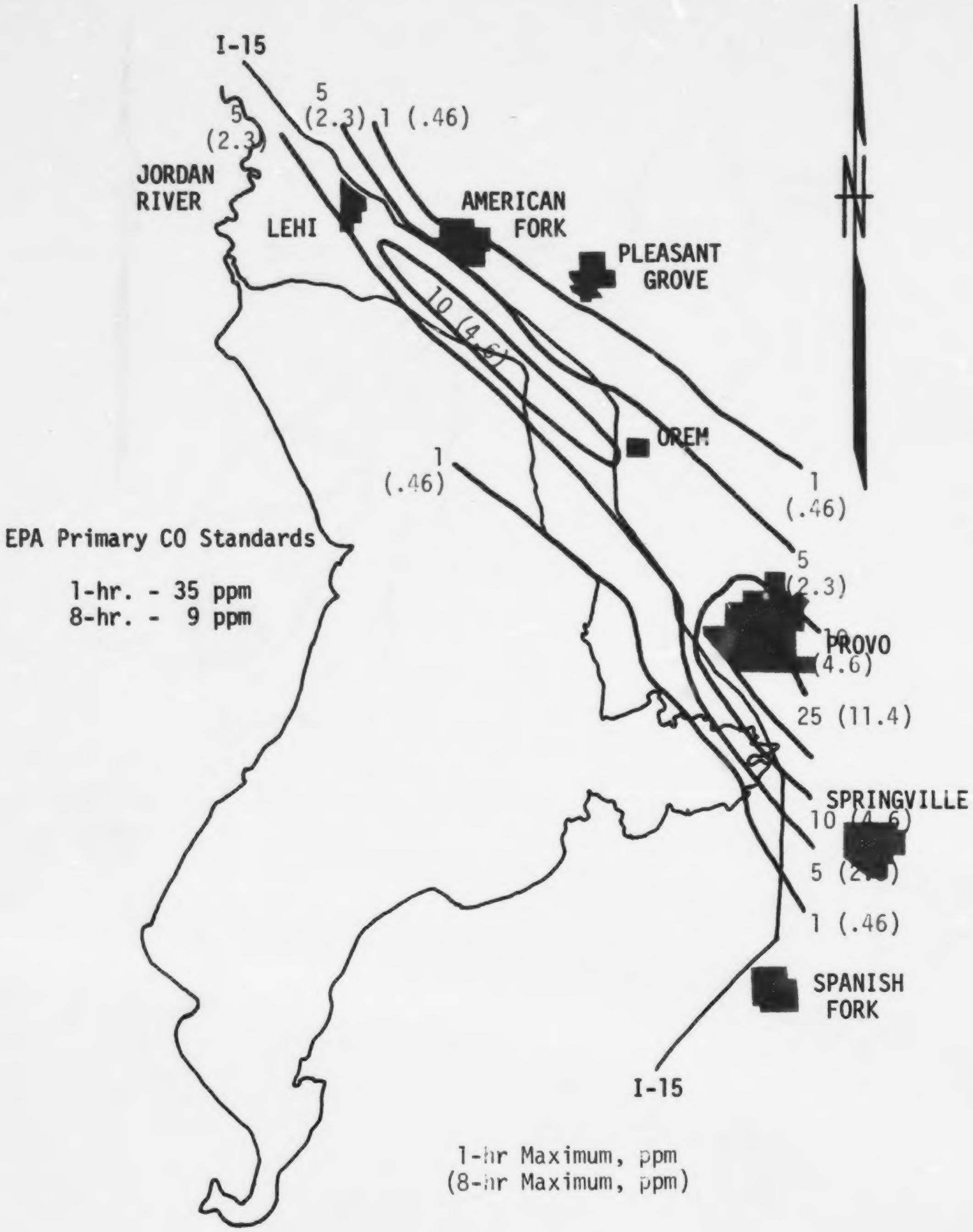

I-15
5
(2.3)
1 (.46)
5
(2.3)
JORDAN
RIVER
LEHI
AMERICAN
FORK
PLEASANT
GROVE
10 (4.6)
N
OREM
1
(.46)
1
(.46)
EPA Primary CO Standards
1-hr. - 35 ppm
8-hr. - 9 ppm
5
(2.3)
10
(4.6)
PROVO
25 (11.4)
SPRINGVILLE
10 (4.6)
5 (2.3)
1 (.46)
SPANISH
FORK
I-15
1-hr Maximum, ppm
(8-hr Maximum, ppm)

FIGURE VI-11

1974 CARBON MONOXIDE CONCENTRATION

PROVO AIR BASIN

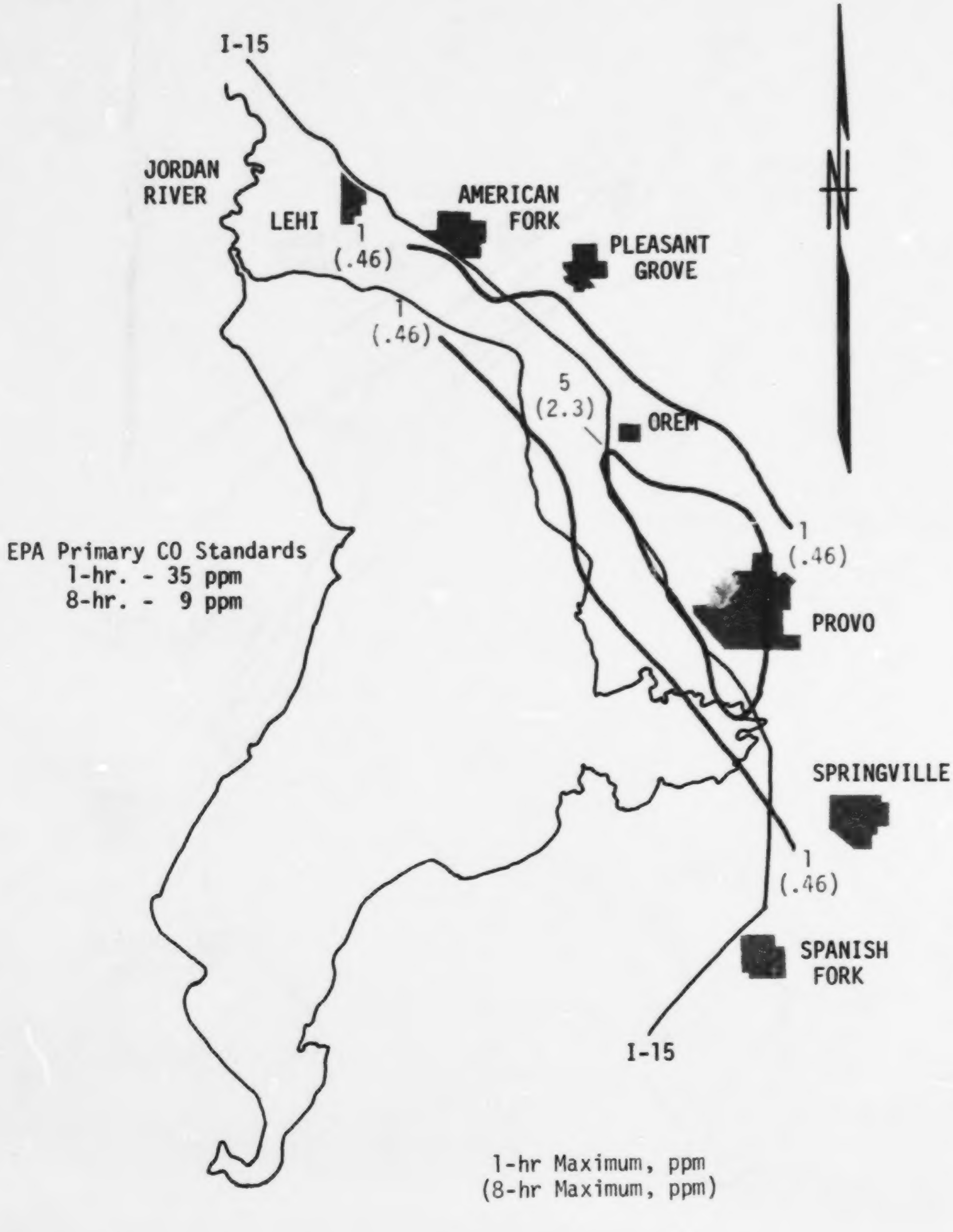

I-15
JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
N
1 (.46)
1 (.46)
5 (2.3)
OREM
1 (.46)
EPA Primary CO Standards
1-hr. - 35 ppm
8-hr. - 9 ppm
PROVO
SPRINGVILLE
1 (.46)
SPANISH FORK
I-15
1-hr Maximum, ppm
(8-hr Maximum, ppm)

FIGURE VI-12

1995 CARBON MONOXIDE CONCENTRATION

PROVO AIR BASIN

These significant reductions in CO concentrations over the Study Area by 1995 in spite of increased development are primarily the result of reductions in line source emissions through automobile exhaust controls.

In order to obtain an estimate of the expected rate of change in carbon monoxide concentrations in the Study Area, CO emissions for the year 1985 were obtained. Dispersion model runs were not made for 1985, but concentrations were estimated using the technique discussed earlier. The resulting isopleths are presented in Figures VI-13 and VI-14.

The isopleths indicate that in 1985 carbon monoxide concentrations over a central region in the Salt Lake City air basin may exceed the 1-hour standard and over a larger area the 8-hour standard may be exceeded. Violation of the 8-hour standard is more likely than is violation of the 1-hour standard. Because of the procedure employed in obtaining the isopleths, and because of the small margin by which standards apparently will be exceeded, additional study should be required before a definitive conclusion is reached.

The isopleths for the Provo air basin indicate that CO concentrations can be expected to be within standards by 1985. Concentrations are significantly lower than standards over the region.

Total Suspended Particulates

Isopleths for total suspended particulates (TSP) in both basins for the 24-hour and annual averages for 1974 and 1995 are shown in Figures VI-15 through VI-22. The 24-hour TSP concentration of 260 ug/m^3 (Figure VI-15) is apparently violated in 1974 in western Salt Lake City where concentrations are estimated to reach 280 ug/m^3 under the assumed "worst case." The 1974 estimated annual average values, Figure VI-16, indicate that the 1-year average standard of 75 ug/m^3 is exceeded over the same general area.

As shown in Figures VI-17 and VI-18, the general pattern for particulate concentrations in the Salt Lake City air basin is expected to continue through 1995. There appears to be a tendency for the contours to move radially outward near the periphery, with attendant decrease in levels near the heart of the metropolitan area. To some extent this would be expected - as the urban area expands and becomes more decentralized, the air in outlying areas tends to become more polluted. The isopleths tend to follow growth and development patterns, modified in this instance by the direction of the prevailing winds, which tend to distort the contours in a north-northwest direction.

The 1974 estimated TSP concentrations for the Provo basin illustrated in Figures VI-19 and VI-20 indicate 24-hour TSP concentrations less than 100 ug/m^3, well below the primary standard of 260 ug/m^3, but annual average TSP concentrations of 80 ug/m^3, slightly above the primary standard of 75 ug/m^3.

As illustrated in Figure VI-21, the 1995 24-hour TSP concentration pattern in the Provo basin is not expected to change much from that in 1974. The 1995 annual average TSP concentration will decrease slightly to just within the primary standard of 75 ug/m^3 but will still be in violation of the secondary standard of 60 ug/m^3 over northwestern Provo.

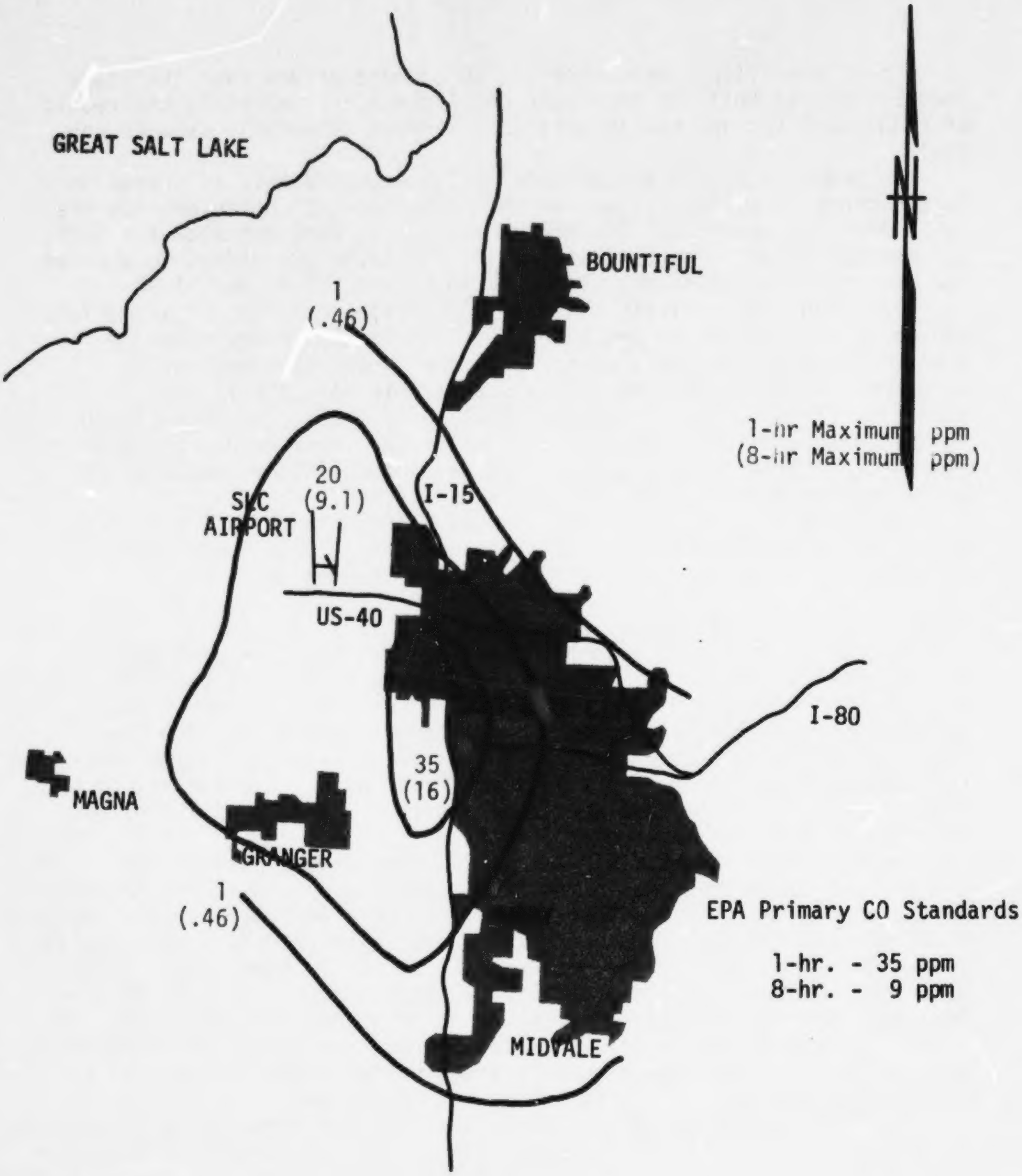

GREAT SALT LAKE
BOUNTIFUL
N
1
(.46)
1-hr Maximum ppm
(8-hr Maximum ppm)
20
(9.1)
SLC
AIRPORT
I-15
US-40
I-80
35
(16)
MAGNA
GRANGER
1
(.46)
EPA Primary CO Standards
1-hr. - 35 ppm
8-hr. - 9 ppm
MIDVALE

FIGURE VI-13

1985 CARBON MONOXIDE CONCENTRATION

SALT LAKE CITY AIR BASIN

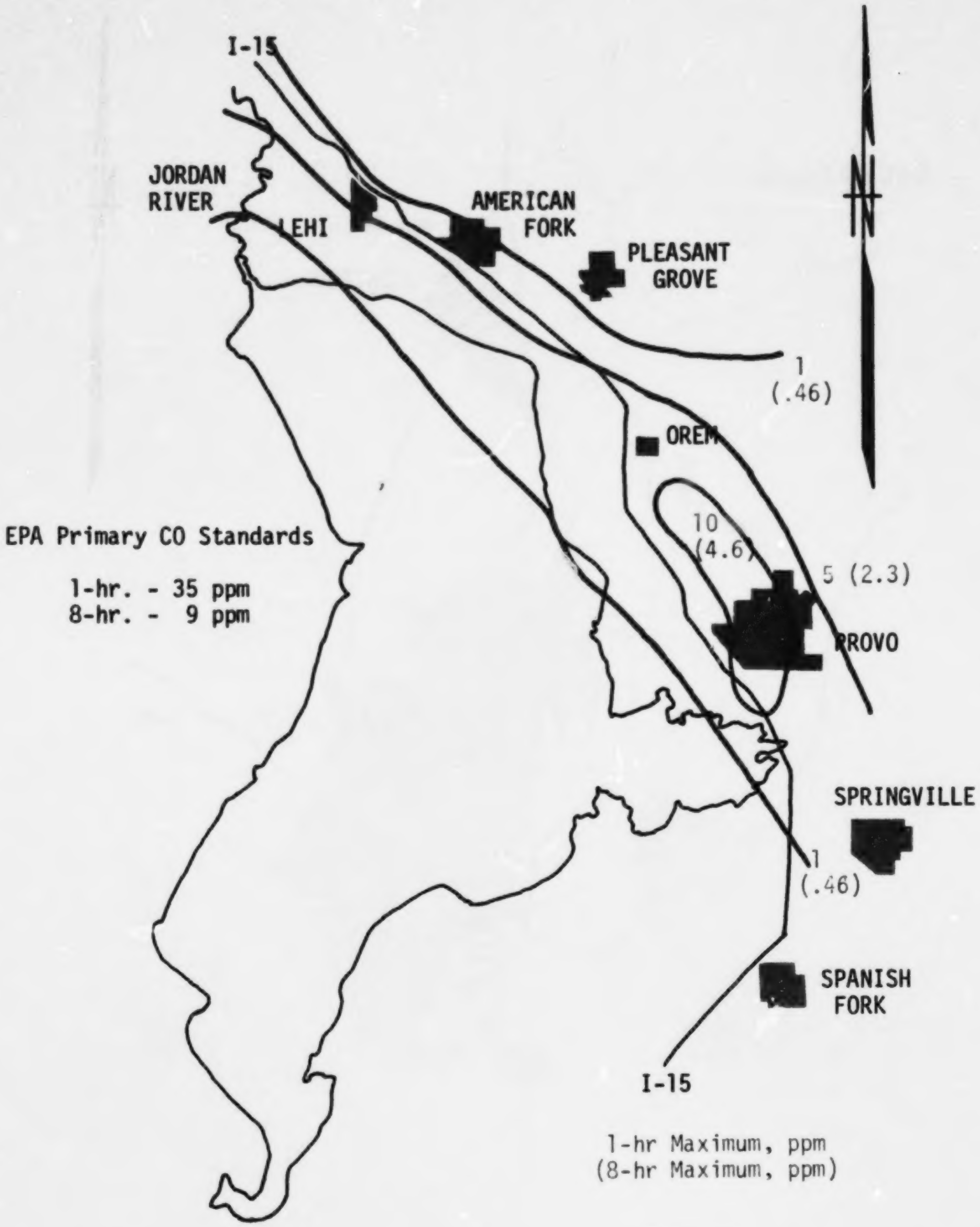

I-15
JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
N
1 (.46)
OREM
10 (4.6)
5 (2.3)
PROVO
EPA Primary CO Standards
1-hr. - 35 ppm
8-hr. - 9 ppm
SPRINGVILLE
1 (.46)
SPANISH FORK
I-15
1-hr Maximum, ppm
(8-hr Maximum, ppm)

FIGURE VI-14

1985 CARBON MONOXIDE CONCENTRATION

PROVO AIR BASIN

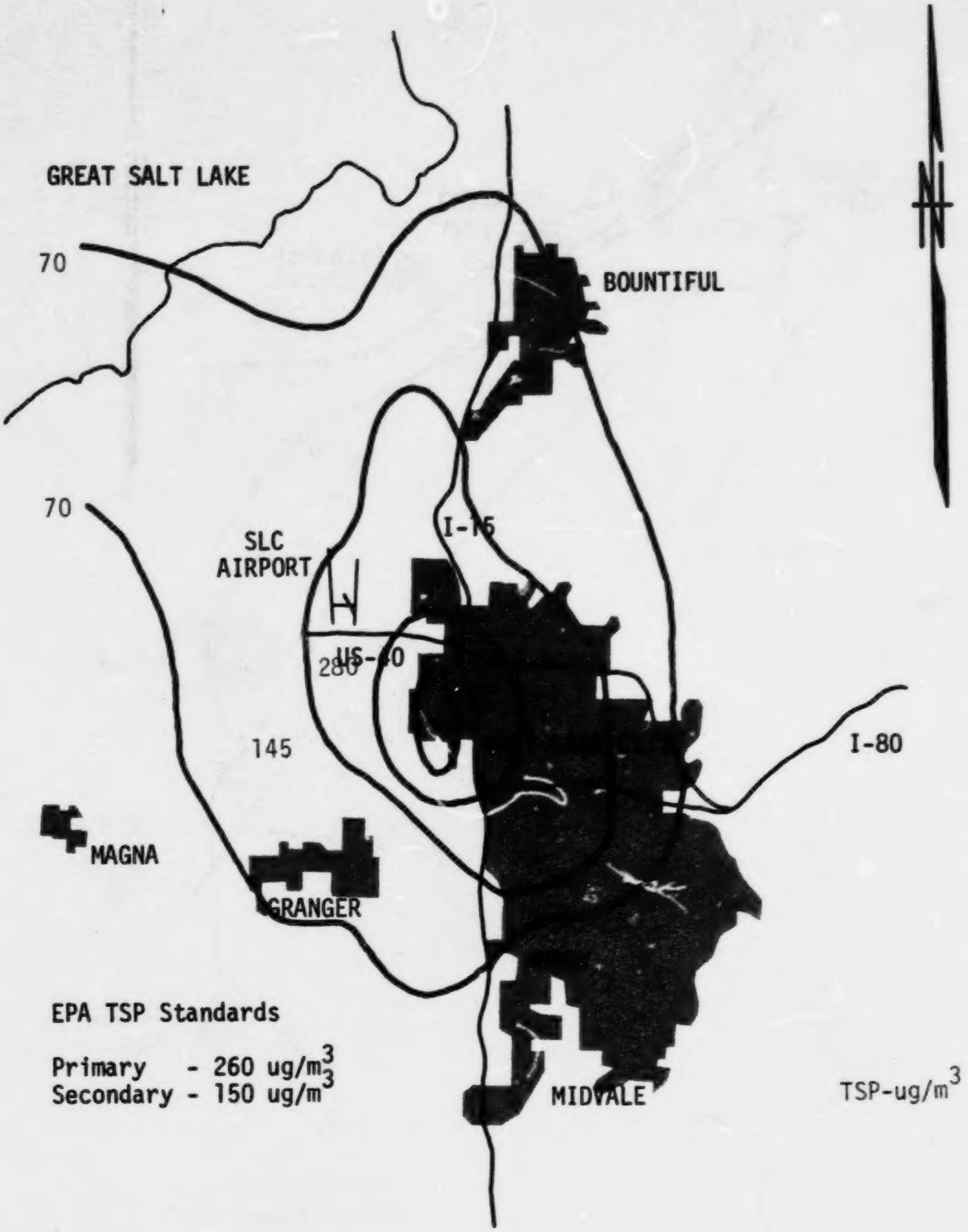

GREAT SALT LAKE
70
BOUNTIFUL
N
70
SLC AIRPORT
I-15
US-40
280
145
I-80
MAGNA
GRANGER
EPA TSP Standards
Primary - 260 ug/m^3
Secondary - 150 ug/m^3
MIDVALE
TSP-ug/m^3

FIGURE VI-15

24-HOUR MAXIMUM PARTICULATE CONCENTRATION

SALT LAKE CITY 1974

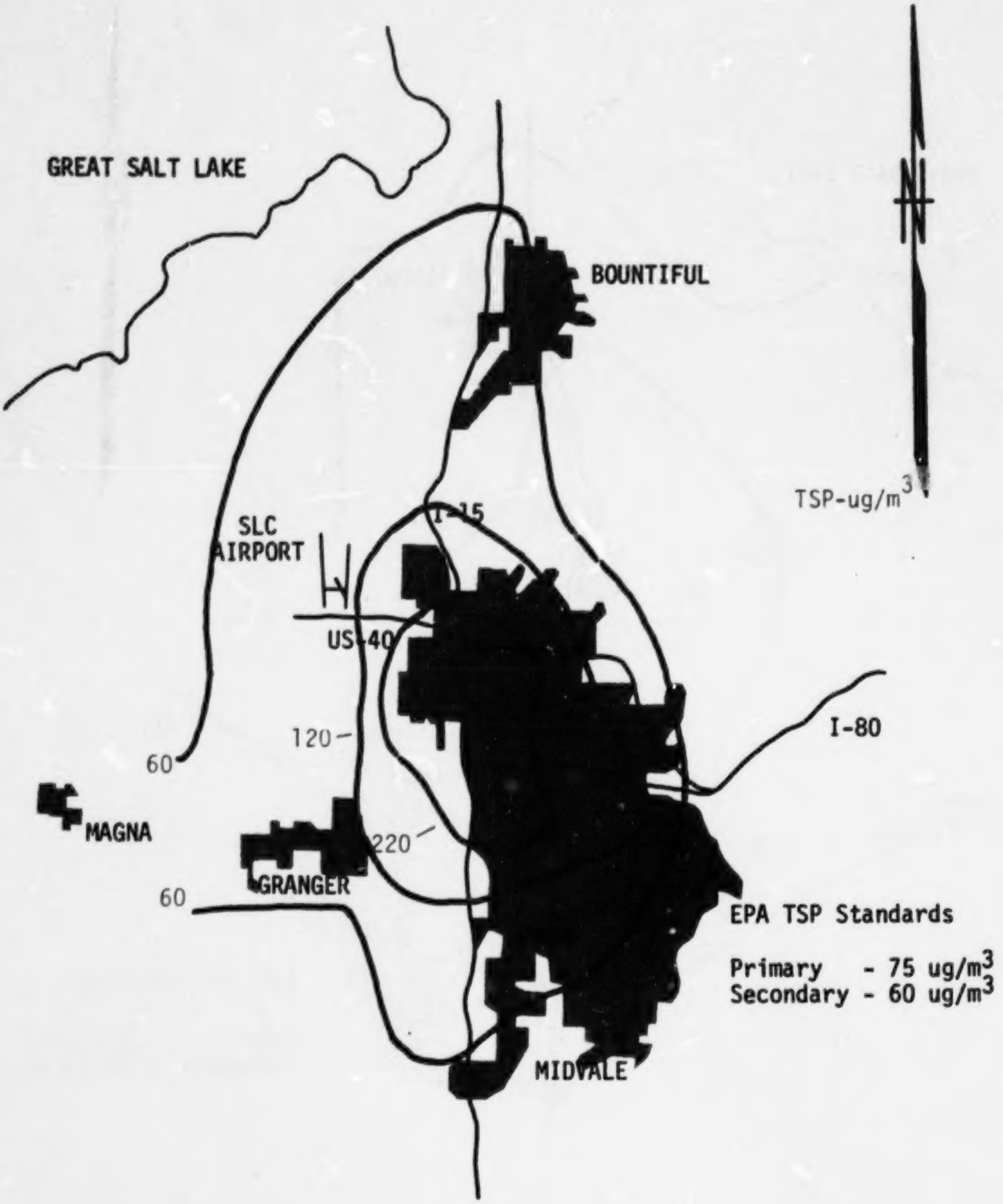

GREAT SALT LAKE
BOUNTIFUL
N
TSP-ug/m3
SLC AIRPORT
I-15
US-40
I-80
120
60
MAGNA
220
GRANGER
60
EPA TSP Standards
Primary - 75 ug/m3
Secondary - 60 ug/m3
MIDVALE

FIGURE VI-16

ANNUAL AVERAGE PARTICULATE CONCENTRATION

SALT LAKE CITY 1974

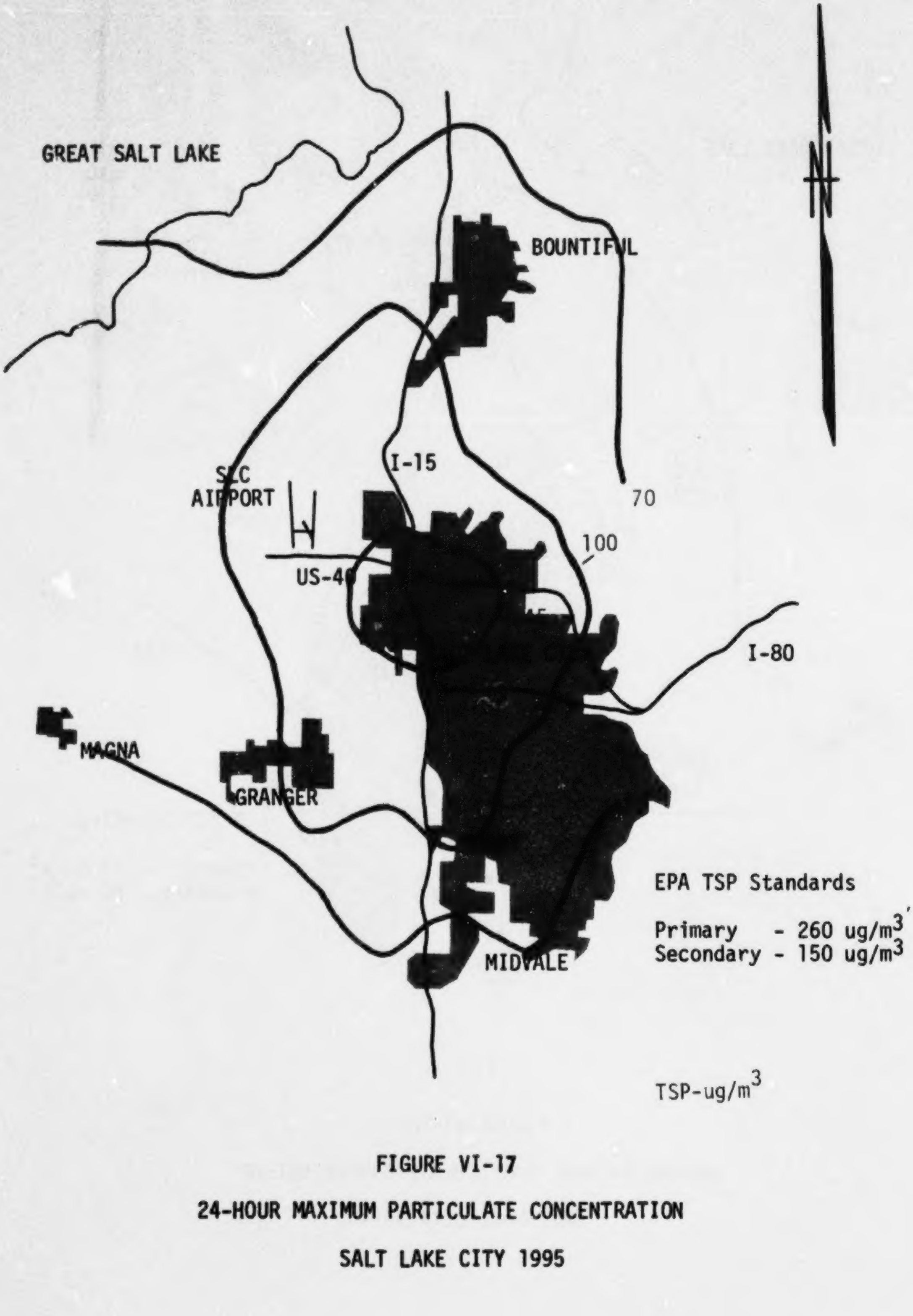

GREAT SALT LAKE
BOUNTIFUL
SLC AIRPORT
I-15
70
100
US-40
I-80
MAGNA
GRANGER
MIDVALE
N
EPA TSP Standards
Primary - 260 ug/m3
Secondary - 150 ug/m3
TSP-ug/m3

FIGURE VI-17

24-HOUR MAXIMUM PARTICULATE CONCENTRATION

SALT LAKE CITY 1995

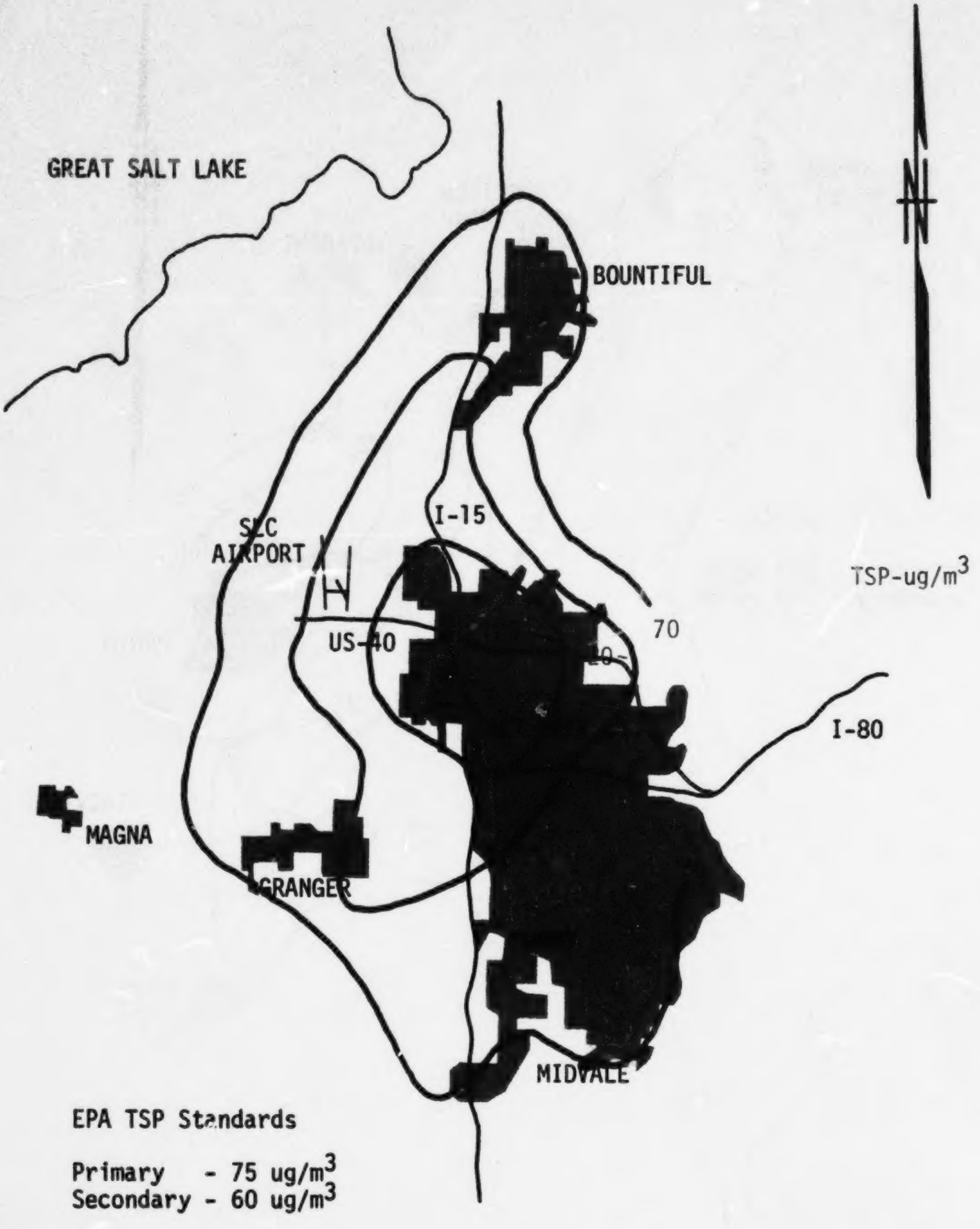
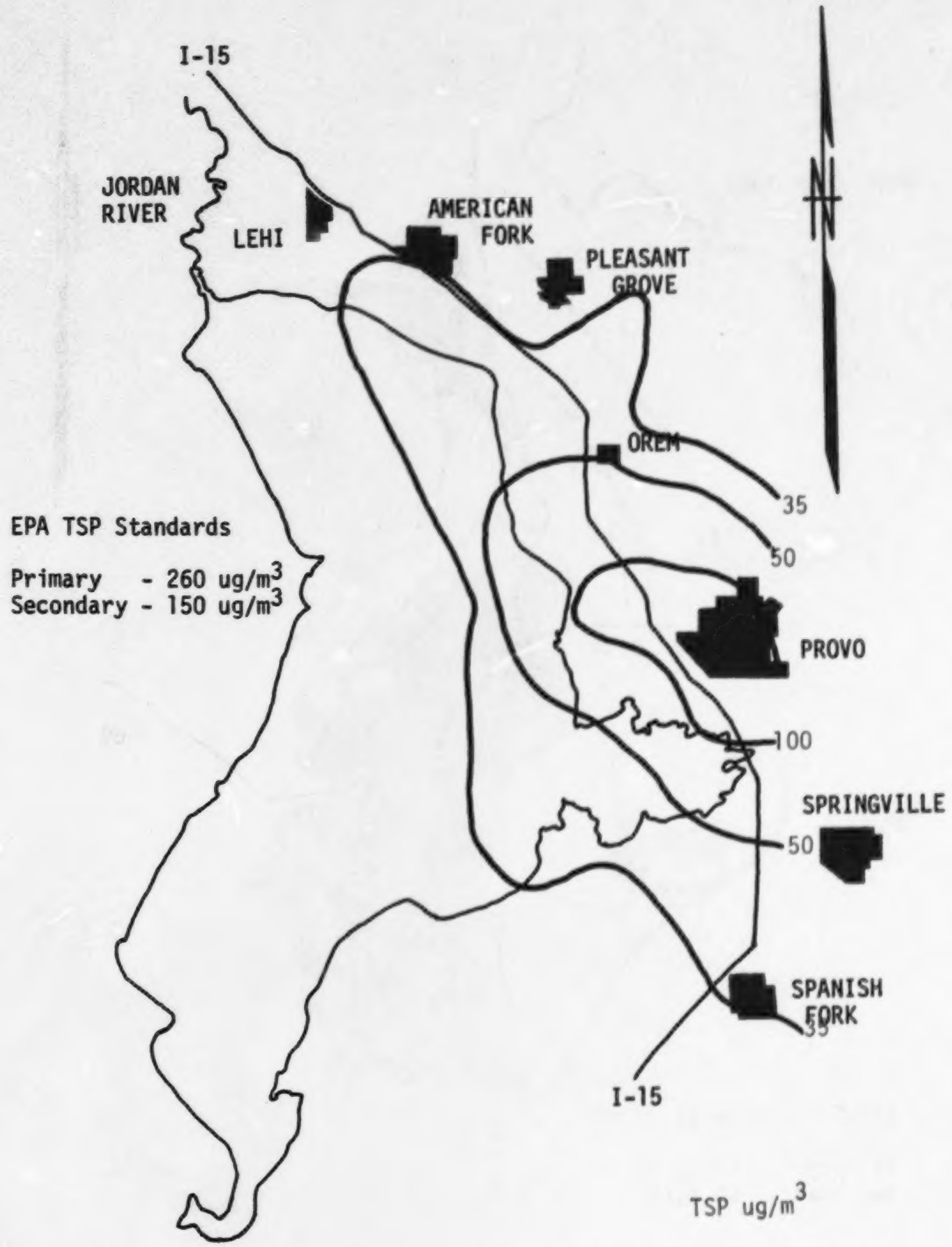

GREAT SALT LAKE
BOUNTIFUL
N
I-15
SLC AIRPORT
TSP-ug/m^3
70
US-40
0
I-80
MAGNA
GRANGER
MIDVALE
EPA TSP Standards
Primary - 75 ug/m^3
Secondary - 60 ug/m^3

FIGURE VI-18

ANNUAL AVERAGE PARTICULATE CONCENTRATION

SALT LAKE CITY 1995


I-15
JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
OREM
35
50
PROVO
100
SPRINGVILLE
50
SPANISH FORK
35
I-15
TSP ug/m^3

EPA TSP Standards

Primary - 260 ug/m^3
Secondary - 150 ug/m^3

FIGURE VI-19

24-HOUR MAXIMUM PARTICULATE CONCENTRATION

PROVO 1974

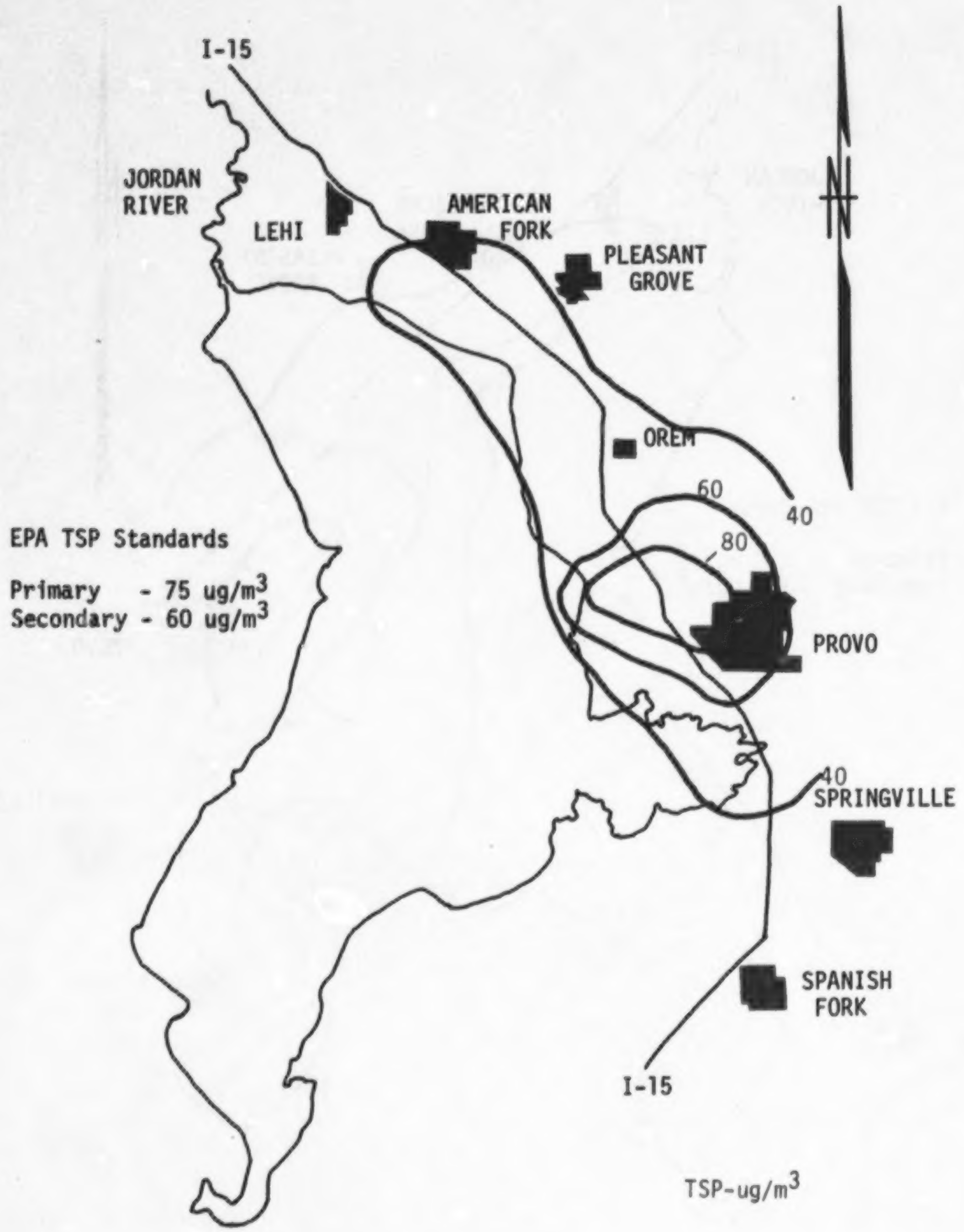
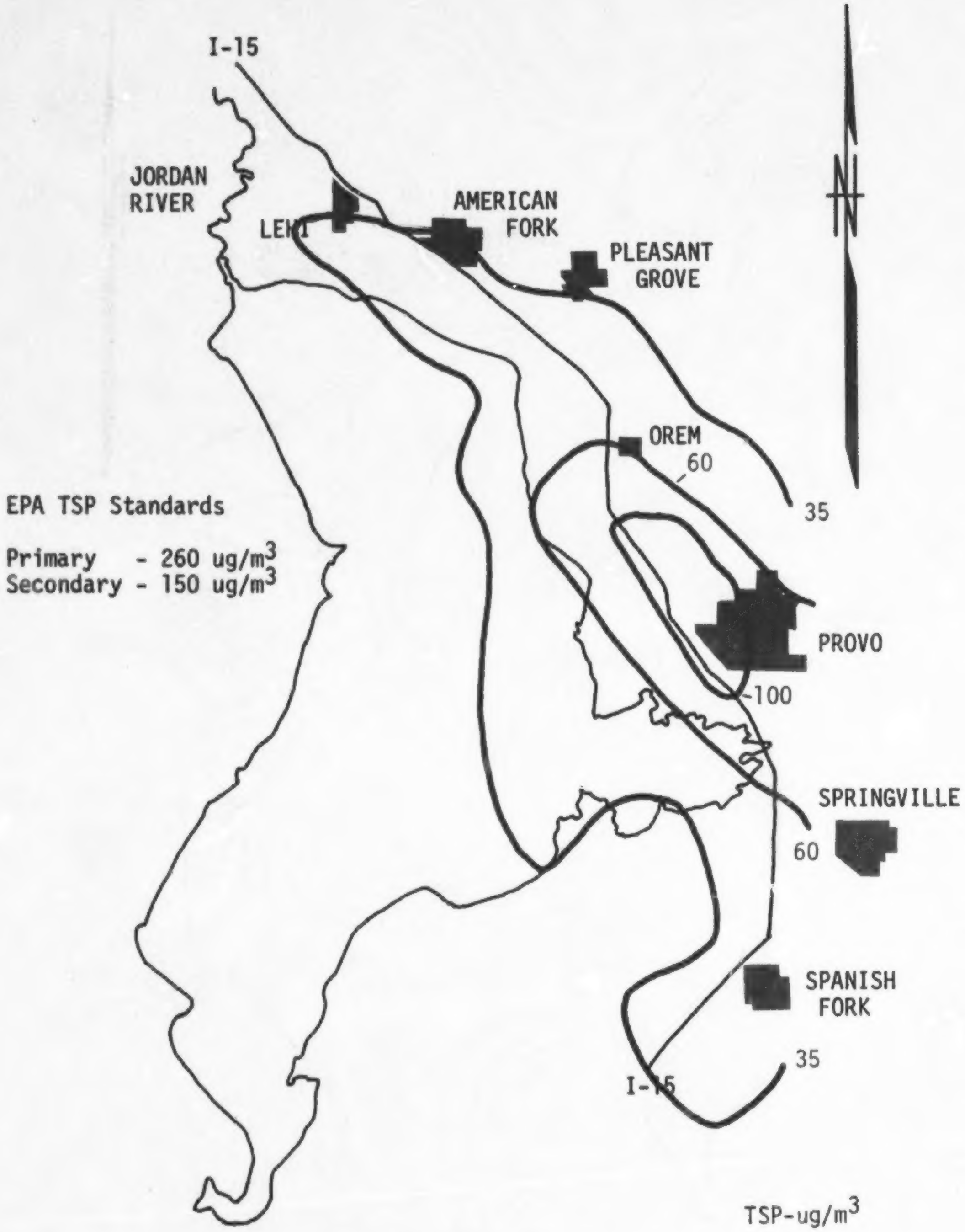

I-15
JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
OREM
60
40
80
EPA TSP Standards
Primary - 75 ug/m^3
Secondary - 60 ug/m^3
PROVO
40
SPRINGVILLE
SPANISH FORK
I-15
TSP-ug/m^3

FIGURE VI-20

ANNUAL AVERAGE PARTICULATE CONCENTRATION

PROVO 1974


I-15
JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
N
OREM
60
35
PROVO
100
SPRINGVILLE
60
SPANISH FORK
35
I-15
TSP-ug/m^3

EPA TSP Standards

Primary - 260 ug/m^3
Secondary - 150 ug/m^3

FIGURE VI-21

24-HOUR MAXIMUM PARTICULATE CONCENTRATION

PROVO 1995

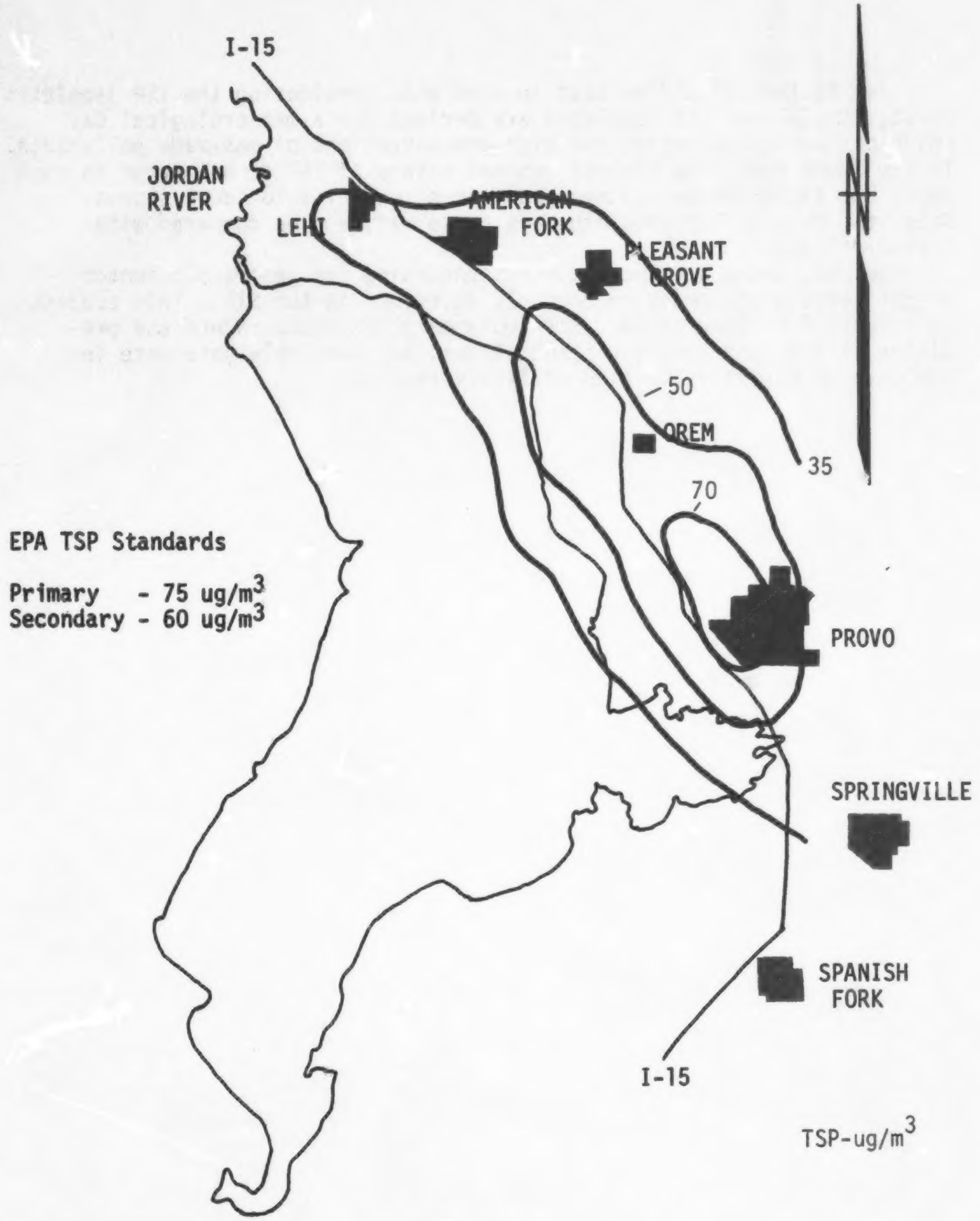

I-15
JORDAN RIVER
LEHI
AMERICAN FORK
PLEASANT GROVE
50
OREM
35
70
EPA TSP Standards
Primary - 75 ug/m3
Secondary - 60 ug/m3
PROVO
SPRINGVILLE
SPANISH FORK
I-15
TSP-ug/m3

FIGURE VI-22

ANNUAL AVERAGE PARTICULATE CONCENTRATION

PROVO 1995

Two factors should be kept in mind when considering the TSP isopleths. First, the 24-hour TSP isopleths are derived for a meteorological day which has a high potential for high concentrations of man-made pollutants. In the Study Area, the highest concentrations of TSP do not occur on such days, but rather under weather conditions conducive to "dust storms." Thus, the 24-hour TSP isopleths are conservative when compared with historical data.

Second, there are uncertainties regarding the geographic impact of the particulate emission controls described in the SIP. This subject is discussed in Chapter IX. SIP implementation could reduce the predicted 24-hour and annual concentrations, but available data were inadequate to permit definition of likely results.

CHAPTER VII

RELATIONSHIP TO OTHER FEDERAL, STATE, AND LOCAL PROGRAMS

INTRODUCTION

The purpose of this Chapter is to present a brief description of the Federal, State, and local programs which may be affected by implementation of the Plan or which affect the Plan implementation. These programs include projects associated with the Central Utah Project, the Jordan-Provo Parkway, Army Corps of Engineers programs, and the Areawide Wastewater Management Planning (208) Programs.

CENTRAL UTAH PROJECT

The Central Utah Project, illustrated in Figure VII-1, is a major statewide effort designed to make Colorado River water available to the urban areas of Salt Lake City and Provo through a series of dams, reservoirs, and aqueducts.

The largest unit of the Central Utah Project affecting the Study Area is the Bonneville Unit which is estimated to cost over $450 million and 25 years to complete. Water from the Uinta Mountains will be diverted through the Strawberry Aqueduct to the enlarged Strawberry Reservoir (270,000 to 1,106,500 acre-feet), then to Utah Valley for further distribution to points both north and south. There will be two additional reservoirs along the Strawberry Aqueduct, which will serve as regulating reservoirs and will also be developed into recreational areas. Water will be released from Strawberry Reservoir through the pressurized Syar Tunnel traversing the Great Basin divide. It will then pass into the Syar, Sixth Water and Dyne power plants, respectively. As the water comes down Diamond Fork Canyon, it will either be stored in the new Hayes Reservoir or be diverted into the Wasatch Aqueduct. Hayes Reservoir will release water into Utah Lake and to the Southern part of Utah County for municipal and agricultural purposes.

Another feature of the Bonneville unit is improved utilization of Utah Lake. The lake has a capacity of more than 850,000 acre-feet but loses an estimated 300,000 acre-feet annually to evaporation. The lake area, under current planning, will be reduced by diking, thus reducing evaporation. Provo Bay and Goshen Bay are proposed to be diked off from the rest of the lake, reducing the surface area by approximately one-third. The water now being lost through evaporation will then be stored in the proposed Jordanelle Reservoir in Wasatch County where the evaporation losses will be greatly reduced as a result of the cooler temperature and reduced surface area. The reclaimed Provo Bay area would be developed into a new agricultural area. It is proposed to develop Goshen Bay as a game preserve. Water from the Jordanelle Reservoir will be released into the Provo River through Deer Creek Reservoir and then to the Jordan Aqueduct. The Jordan Aqueduct will supply water to Salt Lake County. Waters will also be released from Jordanelle Reservoir to meet Northern Utah County municipal

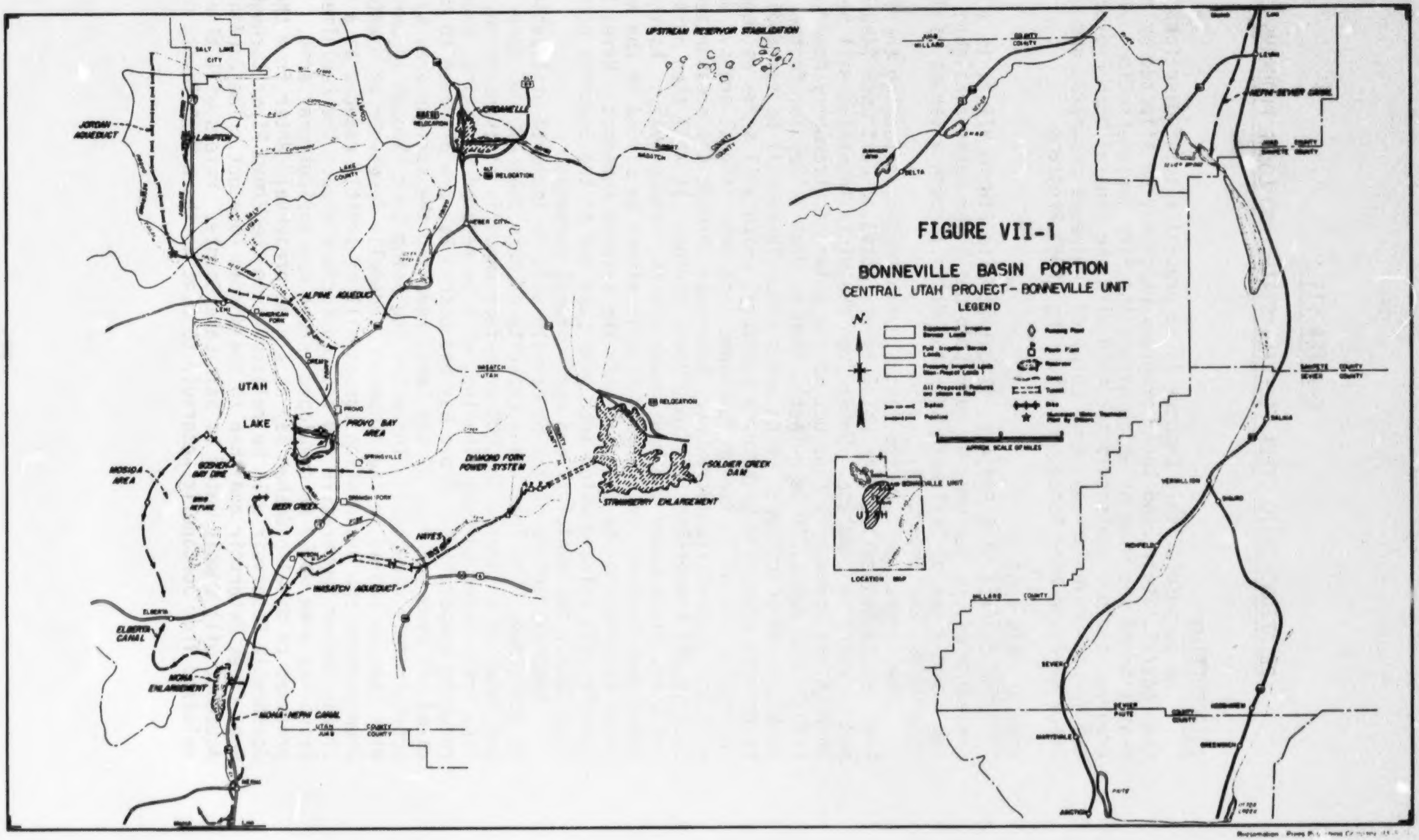

SALT LAKE CITY
JORDAN AQUEDUCT
JORDANELLE
RELOCATION
UPSTREAM RESERVOIR STABILIZATION
WASATCH
SUMMIT COUNTY
LAKE COUNTY
ALPINE AQUEDUCT
LEHI
AMERICAN FORK
UTAH
LAKE
PROVO
PROVO BAY AREA
SPRINGVILLE
MOSIDA AREA
GOSHEN BAY DIKE
BEER CREEK
SPANISH FORK
DIAMOND FORK POWER SYSTEM
HAYES
WASATCH AQUEDUCT
STRAWBERRY ENLARGEMENT
SOLDIER CREEK DAM
ELBERTA
ELBERTA CANAL
MONA ENLARGEMENT
MONA-NEPHI CANAL
UTAH COUNTY
JUAB COUNTY
NEPHI
DELTA
MILLARD COUNTY
NEPHI-SEVER CANAL
SANPETE COUNTY
SEVIER COUNTY
SALINA
VERMILLION
REDMOND
SEVIER
MARYSVALE
GREENWICH
JUNCTION
N.
Reservoir
Tunnel
Dike
Siphon
Pipeline
APPROX. SCALE OF MILES
BONNEVILLE UNIT
UTAH
LOCATION MAP

FIGURE VII-1

BONNEVILLE BASIN PORTION
CENTRAL UTAH PROJECT - BONNEVILLE UNIT
LEGEND

requirements. Flood control and storage on the Jordan River will be facilitated by the proposed Lampton Dam near 9800 Street South. The reservoir and surrounding area is planned as a multipurpose facility and is part of the Salt Lake County Master Plan, under the name of Jordan Lake.

The Argenta Reservoir, with a capacity of 60,000 acre-feet, is planned for upper Big Cottonwood Canyon as storage for its waters and some diverted waters from Little Cottonwood Canyon. The construction of a small reservoir in Dry Creek holding 50,000 acre-feet, to which water from Little Cottonwood Canyon will be diverted, has also been considered.

An enlargement of the existing Mona Reservoir in Northern Juab County on Currant Creek has also been proposed. The enlarged capacity would supplement irrigation needs and provide limited recreation use.

The implementation of the various projects comprising the Central Utah Project can have significant impact on water quality management in the Utah Lake-Jordan River Basins. Large quantities of imported water will tend to increase streamflows thus increasing waste load assimilative capacity of the area's streams. This additional high-quality imported water will also improve water quality through simple dilution.

Other actions within the Central Utah Project may have adverse or unknown impacts on water quality. Diking of Provo Bay will result in a loss of an important fresh water marshland which is the primary assimilator of waste loads to Utah Lake. Provo Bay also serves as an important bird refuge. Additionally, the diking of Provo and Goshen Bays will ultimately change both the biological and chemical make up of Utah Lake. Whether this change will be environmentally beneficial or not is unknown. The construction of Lampton Reservoir on the Jordan River could result in excessive aquatic plants growth because of excess nutrients present in the River; thereby, making the reservoir unsuitable for recreational purposes.

JORDAN-PROVO PARKWAY

In 1971, a study was conducted by Salt Lake County to investigate alternatives to channelization of the Jordan River for flood control purposes. The study report recommended the creation of a park within the flood plain and development of the river for recreation. The recommendations were accepted by the County and as a result, a governmental agency, the Jordan-Provo Parkway Authority, was established to oversee the Parkway development.

The Parkway will include an area bordering the Jordan River from the Jordan Narrows to Farmington Bay and another section along the lower reaches of the Provo River. The park will focus on the natural qualities of the river with bank terracing and landscaping designed to enhance aesthetic values and recreation potential. Land and water rights acquisition for the Parkway is presently in progress.

The Parkway is seen to have a beneficial impact on the Plan in terms of providing more aesthetic opportunities to enjoy the rivers and guaranteeing the right of access to a greater number of people.

However, as indicated in Chapter IV, the Plan is not expected to significantly improve the DO and nutrient concentrations in the Jordan River, although health aspects through improved disinfection practices will be realized. Non-point sources of pollution and stormwater discharges must be controlled before the DO and nutrient problems can be eliminated. Because of the work effort of the 208 Programs in this area, it is anticipated that the water quality of the Jordan River can be improved to a level commensurate with the goals of the Jordan River Parkway.

ARMY CORPS OF ENGINEERS

The Corps of Engineers is heavily involved in several flood control and water resource programs and studies for the Study Area. Recently completed Flood Plain Information Studies include:

- Jordan River - Cudahy Lane to 5700 Street South
- Jordan River - Jordan Narrows to 5700 Street South
- Provo River and Slate Canyon Creek
- Provo River and Rock Canyon Creek
- American Fork River and Dry Creek
- Hobble Creek at Springville
- Mill, Barton, and Stone Creeks.

Other Corps projects include a feasibility study to improve boating facilities on Great Salt Lake near Garfield, flood control projects for the Spanish Fork River and the Surplus Canal, and the Little Dell multipurpose reservoir in Mountain Dell Canyon. A feasibility study is now nearing completion for additional flood control on the Jordan River from 21st Street South to Great Salt Lake. This study parallels the Parkway Authority's efforts to establish the river flood plain as a park. The estimated cost of this project is $28,000,000.

AREAWIDE WASTEWATER TREATMENT MANAGEMENT PLANNING (208) PROGRAMS

There are three ongoing 208 Programs within the Study Area:

- Mountainlands 208 Program (Utah and Wasatch Counties)
- Salt Lake County 208 Program (Salt Lake County)
- Weber River 208 Program (Davis County).

These programs will provide plans for wastewater management over a 20 year planning period and include facilities planning. A number of water quality, non-point source pollution, and land use issues identified in this report are expected to be resolved through the 208 planning process. The three 208 Programs in the Study Area are placing particular emphasis on wastewater treatment facilities planning, non-point source pollution controls, and the institutional arrangements required to implement a viable water quality management plan.

UTAH STATE IMPLEMENTATION PLAN

The Utah State Implementation Plan for the attainment and maintenance of air quality stipulates a variety of strategies which must be implemented in order to achieve required reductions in concentrations of carbon monoxide. These strategies include control of auto emissions, reductions in driving, improved traffic control, and increased use of public transportation and are mandated for attainment of CO standards by July 1977.

The control strategy for carbon monoxide (draft revision, dated May 19, 1975, to Chapter V, Part B, Utah Implementation Plan) calls for a 22 percent reduction in one-hour maximum CO concentrations in Salt Lake City, and no reduction in Provo. The strategy requires a 59 percent reduction in 8-hour maximum concentrations in Salt Lake City, with 55 percent reduction in Provo. The air quality analysis indicates that, by 1995, the one-hour maximum will be reduced by about 59 percent in Salt Lake City and 71 percent in Provo, and that the eight-hour maximum will be reduced about 79 percent in Salt Lake City and 76 percent in Provo. Therefore, carbon monoxide standards should be achieved by 1995; however, based on the air quality analysis, there is some doubt as to the attainment of these standards in the Salt Lake City basin by 1985. Attainment of the CO standards by the currently mandated 1977 deadline is an issue which requires a greater level of analysis than is presented in this report.

CHAPTER VIII

UNAVOIDABLE ADVERSE IMPACTS

INTRODUCTION

Certain adverse environmental impacts are unavoidable by the very nature of implementing a wastewater treatment plan and as a consequence of the development projected to occur. These unavoidable impacts result from constructing facilities and interceptors and the changes in land use which they precipitate. These impacts are presented in Tables VIII-1 to VIII-5 for the various alternatives in each area. An attempt was made to rank the severity of impacts among each area's alternatives. The following discussion is germane to understanding the Tables.

UNAVOIDABLE ADVERSE IMPACTS

The cost of implementing any wastewater treatment alternative can be considered to be an unavoidable adverse impact. As a basis for relating costs among alternatives, the costs of implementing alternatives within each area were considered to yield from limited (L) to severe (S) adverse impacts. These ranked impacts are for purposes of comparing alternatives in Tables VIII-1 to VIII-5 and do not necessarily relate to projected impacts on the population.

Typically, the lower two to four alternatives were judged to have the least (L) impact while the most expensive four or so alternatives had the most (S). The comparison was not made between areas. It is possible that the least costly alternative in one area is more expensive than the most costly in another. Assuming no Study Area wide authority would serve to distribute costs equitably, the above, areal analysis is perceived to be valid.

Economic Burden on Low Income Groups

A more significant measure of unavoidable, adverse economic impacts is found in the economic burden on low income groups. Because Central Utah County and Wasatch County alternatives were estimated to consume between 3.5 to 5.4 percent of low income families annual income, they were rated severe (S) in unavoidable adverse impact. In comparison, Salt Lake County alternatives were considered to yield limited (L) unavoidable adverse economic impacts on low income families because they require less than 2.9 percent of annual income.

Increased Non-Point Pollution

As development occurs, the changes in land use activities will alter the quantity of non-point source (runoff) pollution. The increase in runoff pollution (if any) is dependent upon the land use changes, control practices, and the parameter in question; however, different increases caused by various alternative wastewater treatment schemes within an area cannot be estimated at this level of planning. A comparison can only be made between areas. Additionally, not all non-point pollution is unavoidable. The current 208 Programs are analyzing non-point control measures, but these potential controls are not considered in the analysis presented herein.

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Increased Point Source Pollution

Increases in point pollution result from development and vary with the treatment level and parameter considered. Based on the waste load estimates presented in Chapter IV, increases in point source pollution are judged moderate in Central Utah County and of no concern in Wasatch County. A negligible to limited unavoidable adverse impact is anticipated elsewhere.

Disruption of Aquatic Habitat

Certain adverse impacts on the aquatic habitats are unavoidable during and after construction of new outfalls or discharge locations. The most serious of problems can be expected in Davis County, Central Utah County, and Wasatch County where alternatives include new discharge locations. No significant unavoidable adverse impacts on aquatic habitats are anticipated elsewhere in the Study Area.

Encouragement of Sprawl Development

Without strict land use controls, the impetus for sprawl, linear, or scattered development is greatest in those alternatives which include long interceptors. The potential for unavoidable adverse impacts resulting from this kind of development was considered severe for most regional alternatives. The exception occurs in Salt Lake County where new interceptors will cross already developed land or land which will probably experience development with or without interceptors.

Disruption of Canyonlands

The disruption of canyonlands is a significant unavoidable adverse environmental impact in Central Utah County for all alternatives simply because growth and development will place more pressure on canyonland recreational uses. If WC-6 was implemented in Wasatch County, the disruption of Provo Canyon would be severe because of the growth induced by the canyon interceptor.

Localized Aesthetic Problems

Localized aesthetic problems are an unavoidable adverse environmental impact in areas where treatment plants are to be maintained in close proximity to residential development. Potential odors and psychological resentment most likely cannot be totally avoided in these areas. These unavoidable impacts are most significant in Davis County, Salt Lake County, and Northern Utah County because of the proximity of some plants to residential development.

Potential Water Rights Problems

Potential water rights issues may present a problem in those alternatives which include a relocation of existing discharges. The more the regionalization, the higher the potential for adverse water rights impacts. Whether or not these impacts can be avoided can only be answered at the time of implementation.

Disruption of Terrestrial Ecosystem

Disruption of the terrestrial ecosystem in some areas is unavoidable during construction of sewage works and as a consequence of subsequent development. In general, the alternatives which include regionalization, long interceptors, and/or new plant sites and outfalls are considered to present the most severe adverse impacts.

Archaeological/Historic Site Impacts

The level of existing planning is not sufficiently detailed to precisely judge the potential for unavoidable adverse impacts associated with archaeological and historic sites. Plan alternatives including expansions, new interceptors, or outfalls in the vicinity of known sites were judged to have a severe impact. Further planning together with archaeological and historical surveys will have to be accomplished to refine these judgements.

Flood Hazards

Unavoidable flood hazards are minimal in the Study Area. Only the Murray and Tri-Community facilities in Salt Lake County are within defined flood plains. For Salt Lake County alternatives which include these facilities, the unavoidable adverse impact for potential floods was judged severe.

Air Quality

Although unavoidable adverse air quality impacts are not amenable to presentation in tabular form because all wastewater treatment alternatives are based on a common land use plan, certain adverse air quality impacts could result from Plan implementation. Over 70 percent of the TSP emissions are not regulated by the State Implementation Plan (SIP) and include several types of sources which may increase as a result of urban growth and development. For example, TSP emissions from road and building construction activities, emissions from space heating, and emissions from sanding of streets and highways might be expected to increase. TSP emissions from automotive vehicles may increase because the number of vehicle-miles driven more than offsets expected reductions in emissions per vehicle-mile. On the other hand, a few types of emissions may decrease (e.g., emissions from agricultural activities as farmlands are connected to other uses, and entrained dust from travel over unpaved roads). In total, while the SIP makes provision for significant reductions in the more readily controllable emissions from point sources, possible increases in the factors that contribute most to high particulate pollutant levels may tend to offset the gains obtained through implementation of the SIP. Not all of these adverse impacts are unavoidable. Several mitigating measures beyond the SIP for control of future TSP concentrations are presented in Chapter IX.

TABLE VIII-1

UNAVOIDABLE ADVERSE IMPACTS

Unavoidable Adverse Impacts	Wastewater Treatment Alternatives Davis County													
	1	2	3	4	5	6	7	8	9	10	11	12	13	REC
Cost of Implementation	S	L	S	M	S	M	S	M	M	M	L	M	L	L
Economic Burden on Low Income Groups	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Increased Non-Point Pollution	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L
Increased Point Source Pollution	N/L	L	L	L	L	L	L	L	L	L	L	L	L	L
Disruption of Aquatic Habitat	L	L	L	L	L	L	L	L	M	L	L	L	L	L
Encouragement of Sprawl Development	L	L	L	L	S	S	S	S	S	L	L	S	S	S
Disruption of Canyonlands	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Localize Aesthetic Problems	M	M	M	M	M	M	M/S	M/S	M/S	M/S	M/S	M/S	M/S	M/S
Potential Water Rights Problems	N	N	N/L	N/L	L/M	L/M	L/M	L/M	M	L/M	L/M	M	M	M
Disruption of Terrestrial Ecosystem	N/L	N/L	L	L	M/S	M/S	M/S	M/S	M/S	M/S	M/S	M/S	M/S	M
Archaeological/Historic Site Impacts	N	N	N	N	N	N	N	N	S	N	N	N	N	S
Flood Hazards	N	N	N	N	N	N	N	N	N	N	N	N	N	N

LEGEND:
S = Severe Adverse Impact
M = Moderate Adverse Impact
L = Limited Adverse Impact
N = No Adverse Impact

TABLE VIII-2

UNAVOIDABLE ADVERSE IMPACTS

Unavoidable Adverse Impacts	Wastewater Treatment Alternatives Salt Lake County 1	2	3	4	5	6	7	8	9	10*	11	12
Cost of Implementation	S	M	S	L	S	S	S	M	L	L	M	M
Economic Burden on Low Income Groups	L	L	L	L	L	L	L	L	L	L	L	L
Increased Non-Point Pollution	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L
Increased Point Source Pollution	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L
Disruption of Aquatic Habitat	N/L	L	N/L	L	N/L	N/L	N/L	N	L	N/L	N/L	N/L
Encouragement of Sprawl Development	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L
Disruption of Canyonlands	N	N	N	N	N	N	N	N	N	N	N	N
Localize Aesthetic Problems	M	M	M	M	M	L/M	L/M	L/M	M	L/M	L/M	L/M
Potential Water Rights Problems	N	N	L	L	M	M/S	S	S	M	M/S	S	M/S
Disruption of Terrestrial Ecosystem	N/L	N/L	M	M	M	M	M	M/S	M	M	M	M/S
Archaeological/Historic Site Impacts	N	N	S	S	S	S	S	S	S	S	S	S
Flood Hazards	S	S	S	S	S	N	N	N	S	N	N	N

LEGEND:
S = Severe Adverse Impact
M = Moderate Adverse Impact
L = Limited Adverse Impact
N = No Adverse Impact

* Recommended Plan

TABLE VIII-3

UNAVOIDABLE ADVERSE IMPACTS

	Wastewater Treatment Alternatives Northern Utah County												
Unavoidable Adverse Impacts	1	2	3	4	5	6	7	8	9	10	11	12	REC
Cost of Implementation	S	L	M	S	S	L	M	L	S	Not Currently Valid	Not Currently Valid	Not Currently Valid	L
Economic Burden on Low Income Groups	M	M	M	M	M	M	M	M	M				L
Increased Non-Point Pollution	N	N	N	N	N	N	N	N	N				N
Increased Point Source Pollution	L	L	L	L	L	L	L	L	L				L
Disruption of Aquatic Habitat	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L				N/L
Encouragement of Sprawl Development	L	L	L	L	S	S	S	S	S				S
Disruption of Canyonlands	N	N	N	N	N	N	N	N	N				N
Localize Aesthetic Problems	L/M	L/M	L/M	L/M	M	M	L	L/M	L/M				M
Potential Water Rights Problems	N	N	S	L/M	M	M	M	S	S				M
Disruption of Terrestrial Ecosystem	N/L	N/L	L	L	M	M	M/S	M/S	M				M
Archaeological/Historic Site Impacts	N	N	N	N	N	N	N	N	N				N
Flood Hazards	N	N	N	N	N	N	N	N	N				N

LEGEND:
S = Severe Adverse Impact
M = Moderate Adverse Impact
L = Limited Adverse Impact
N = No Adverse Impact

TABLE VIII-4

UNAVOIDABLE ADVERSE IMPACTS

	Wastewater Treatment Alternatives Central Utah County												
Unavoidable Adverse Impacts	1	2	3	4	5	6	7	8	9	10	11	12	REC
Cost of Implementation	S	M	S	M	S	L	M	S	M	M	S	L	L
Economic Burden on Low Income Groups	S	S	S	S	S	S	S	S	S	S	S	S	S
Increased Non-Point Pollution	N	N	N	N	N	N	N	N	N	N	N	N	N
Increased Point Source Pollution	L/M	M	L/M	M	L/M	M	M	M	M	M	L/M	M	M
Disruption of Aquatic Habitat	N/L	N/L	N/L	N/L	N/L	N/L	L/M	L/M	L/M	L/M	N/L	N/L	N/L
Encouragement of Sprawl Development	L	L	S	S	S	S	S	L	S	S	S	S	S
Disruption of Canyonlands	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M
Localize Aesthetic Problems	L/M	L/M	M	M	M	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M
Potential Water-Rights Problems	N	N	N/L	N/L	M	M	M/S	M/S	M/S	S	S	S	M
Disruption of Terrestrial Ecosystem	N/L	N/L	M	M	M	M	M/S	M/S	M/S	M/S	M/S	M/S	L
Archaeological/Historic Site Impacts	N	N	N	N	N	N	S	S	S	S	S	S	N
Flood Hazards	N	N	N	N	N	N	N	N	N	N	N	N	N

LEGEND:
S = Severe Adverse Impact
M = Moderate Adverse Impact
L = Limited Adverse Impact
N = No Adverse Impact

TABLE VIII-5

UNAVOIDABLE ADVERSE IMPACTS

	Wastewater Treatment Alternatives Wasatch County						
Unavoidable Adverse Impacts	1	2	3	4	5	6	REC
Cost of Implementation	M	L	M	L	S	S	L
Economic Burden on Low Income Groups	S	S	S	S	S	S	S
Increased Non-Point Pollution	N	N	N	N	N	N	N
Increased Point Source Pollution	N	N	N	N	N	N	N
Disruption of Aquatic Habitat	N/L	L/M	L/M	N/L	N/L	N/L	L/M
Encouragement of Sprawl Development	L	L	S	S	S	S	S
Disruption of Canyonlands	N	N	N	N	N	S	N
Localize Aesthetic Problems	M	M	N	N	N	M	N
Potential Water Rights Problems	N	M	S	S	S	S	S
Disruption of Terrestrial Ecosystem	N/L	L	S	S	S	S	S
Archaeological/Historic Site Impacts	N	N	N	N	N	S	N
Flood Hazards	N	N	N	N	N	N	N

LEGEND:
S = Severe Adverse Impact
M = Moderate Adverse Impact
L = Limited Adverse Impact
N = No Adverse Impact

CHAPTER IX

MITIGATING MEASURES

Mitigating measures are those actions which can be taken in conjunction with implementation of any wastewater treatment alternative to reduce or compensate for adverse environmental impacts associated with implementation. The following mitigating measures have been identified:

1. Land use management including zoning, tax incentives, sewer use ordinances, tap fees, etc., to minimize undesirable development patterns resulting from plan implementation.
2. Extensive and intensive non-point source monitoring and evaluation program to identify and quantify the character of non-point pollution contributing to poor water quality and the development of cost effective control strategies. This is particularly important in the lower Jordan River area where stormwater runoff appears to be a major problem. The ongoing 208 Programs are focusing on the non-point source problems.
3. Identification and quantification of infiltration/inflow problems and the implementation of abatement programs to decrease demands on sewer and treatment plant capacities. This is particularly important in the Heber Valley area.
4. Analysis of potential tax relief mechanisms to ease the economic burden on low income groups.
5. Archaeological and historical site reconnaissance prior to final plan implementation to minimize potential for adverse impacts on these types of sites.
6. Maintenance of proper techniques during construction of facilities and interceptors to minimize problems such as:
    a. dust
    b. noise
    c. air pollution
    d. runoff pollution
    e. loss of vegetation and wildlife.
7. Reanalysis of land disposal and recycle-reuse options as a means of minimizing impact of wastewater effluents on surface streams. This issues is being investigated by the ongoing 208 Programs.
8. Strict controls on canyonland development and use to minimize impact of increased demand from future growth.
9. Where existing facilities are abandoned, restore land to some other useful purpose such as parks, etc.
10. Return of interceptor corridors to native ecosystem after construction.
11. Landscaping, aesthetic design, odor control, etc., particularly at the following treatment plants:

  a. North Davis
  b. Central Davis
  c. Granger-Hunter
  d. Cottonwood
  e. Murray
  f. Tri-Community
  g. Sandy
  h. American Fork
  i. Springville
  j. Heber

12. Utilization of dispersion and diffusion tubes on lake outfalls to minimize localized adverse water quality impacts. Alternatives include DC-3 through DC-13, SLC-8, SLC-12, NUC-3, NUC-4, NUC-7, NUC-8, NUC-10 through NUC-12, and CUC-7 through CUC-12.
13. Adequate flood proofing and flood protection at the Murray and Tri-Community facilities for alternatives SLC-1 through SLC-5, and SLC-9.
14. Protection of wildlife habitat in designated refuges during construction of alternatives DC-9, CUC-5 through CUC-12, and the CUC recommended plan.
15. Special construction techniques to minimize disruption of Jordan River ecosystem as a result of interceptors crossing the River in alternatives SLC-3 through SLC-12 and the SLC recommended plan.

16. Because CO concentrations in 1995 are expected to be below standards, no specific mitigating measures are required in general. However, there will probably be local places where CO concentrations will exceed one and 8-hour standards on particular occasions resulting from local heavy traffic. These conditions should be anticipated and strategies developed to mitigate their effects. Compliance with CO standards will be difficult through much of the intervening period and careful monitoring of CO concentrations will be necessary to determine the effectiveness of the SIP.

17. Particulate concentrations are expected to exceed standards in 1995. The magnitude of the particulate problem is illustrated by the fact that only 30 percent of the particulate emissions in the Study Area come from man-made point sources for which Utah State Implementation Plan controls are applicable. Control measures, such as those embodied in the SIP, should certainly be implemented, but a 50 percent reduction in emissions from sources subject to control may reduce the total Study Area TSP emissions by only 15 percent. Mitigating measures beyond those described in the SIP may be needed. Chemical stabilization

or sprinkling of dirt surfaces, construction of windbreakers, and reduced sanding of roads could be effective in reducing fugitive dust. Energy conservation and decreased automotive traffic in some regions could reduce man-made TSP emissions over the critical areas. Further study would be necessary to find the most practical and cost-effective mitigating measures for the Study Area.

CHAPTER X

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Most major construction activities or plan implementation can be expected to cause irreversible or irretrievable commitments of human and natural resources either within the useful life of the project or some other reasonable time frame. There are numerous such commitments inherent within the wastewater treatment alternatives. They include:

1. The energy, concrete, steel, other construction materials, chemicals, and manpower required to build, operate, and maintain the facilities, interceptors, and outfalls.
2. Implementation of the Plan will foreclose certain future growth control options.
3. Land development made possible by construction of any set of alternatives will irreversibly commit land to other uses. Once developed, these new growth areas are unlikely to revert to a natural condition or to agricultural use.
4. An appreciable amount of land will be committed to use for wastewater treatment purposes.
5. A significant amount of Federal, State, and local money will be irretrievably committed to construct, operate, and maintain the sewage works.
6. Except for alternatives including lake outfalls, no alternatives foreclose future recycle-reuse options.
7. Land development and the associated urban growth will irretrievably commit air resources as a receptor of CO and TSP emissions. Such a commitment may affect the health and well being of the Study Area population.

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CHAPTER XI

RELATIONSHIP BETWEEN LOCAL SHORT TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

The purpose of this Chapter is to define the extent to which the Plan involves tradeoffs between short term and long term environmental gains, and the extent to which implementation of the Plan forecloses future options. These issues are discussed in the following:

1. The increased wastewater effluent quality resulting from Level III or Level IV treatment may have marginal long term beneficial impacts on water quality in surface streams without management of non-point sources.
2. Alternatives utilizing secondary treatment do not foreclose the option for Level III, Level IV, or other higher level of treatment in the future should circumstances warrant.
3. Except for those alternatives containing recommendations for lake outfalls, no alternatives preclude future consideration of land disposal, The capital costs of long outfall lines are perceived to be an impediment to future ultimate disposal options such as land disposal.
4. Regionalization schemes may sacrifice long term environmental enhancement of one area at the expense of another.
5. Sewering of Provo Canyon has the short term benefit of eliminating discharges to the upper Provo River, but long term environmental enhancement may be adversely impacted by increased growth and high density development induced by the interceptor.
6. Windfall profits may result from any major regionalization schemes, including the Provo Canyon interceptor, as the value of undeveloped land adjacent to interceptors increases in value.
7. The short term gain in water quality realized by regionalization in Heber Valley may be offset by long term losses as a result of an effluent discharge closer to Deer Creek Reservoir.
8. Short term water quality gains in the Study Area due to implementation of Level III treatment may have insignificant long term advantage over secondary treatment without control of non-point sources.
9. Development of agricultural lands will not necessarily result in elimination or disruption of particularly unique vegetation associations, but the elimination of tilled acreage and a commitment of it to development will place increased pressure on the wildlife that is dependent upon the man-created habitat.
10. With regards to carbon monoxide as an air pollutant, no significant short term (1977) change in air quality is indicated, but the long term (1995) impacts include a marked improvement in CO concentrations.
11. With regard to particulates as an air pollutant, no significant short term (1977) change is air quality is indicated. For the long term (1995), improvements in TSP concentrations will be slight, but violations of air quality standards are to be expected.

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CHAPTER XII

ALTERNATIVE COURSES OF ACTION

The Utah Lake-Jordan River Water Quality Management Plan recommends expansion of wastewater treatment facilities through regionalization along with upgrading treatment efficiencies to meet Utah's Level III effluent requirements. The water quality regulations of Utah establish effluent requirements of Level III treatment prior to discharge of domestic wastewater by July, 1980. These 1980 effluent requirements provide for a high degree of removal of BOD, suspended solids and coliform bacteria. The State of Utah considers these effluent requirements necessary to reduce, to an acceptable level, the health hazard associated with wastewater effluents as well as to achieve in-stream water quality standards. As permitted under Section 510 of the Federal Water Pollution Control Act, the State of Utah has established these Level III effluent requirements which are more stringent than those called for under the time-tables in the Federal Act.

EPA's secondary treatment effluent limitations, are presently required to be met by all domestic wastewater discharges by July, 1977. In accordance with the Federal Water Pollution Control Act, EPA has determined that these National secondary treatment requirements are adequate for treatment of domestic wastewater, if water quality standards are not violated by the effluent discharged. Where necessary to attain water quality standards or where shown to be cost-effective, EPA supports the use of more advanced treatment levels resulting in a higher quality effluent.

The relationship between point and non-point pollution sources in determining in-stream water quality may create situations where advanced treatment levels such as Utah's Level III requirements are not needed immediately. Within the Study Area both point and non-point pollution sources cause violations of Utah's in-stream water quality standards. The Plan recommends controls for domestic wastewater point sources by specifying Level III effluent requirements throughout the study area. However, without the addition of non-point source controls, it is probable that in-stream water quality standards will not be achieved in some instances.

The three 208 Areawide Waste Treatment Management Planning Agencies which cover the Utah Lake and Jordan River Study Area will be recommending methods for control of non-point pollution sources. In areas where non-point pollution is the significant source, an evaluation of the degree of non-point vs. point controls can best be made by these on-going 208 programs. In determining funding priorities over the next few years, it would appear to be advisable to analyze the costs and water quality benefits of various treatment levels and non-point source controls to

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determine the most cost-effective approach to meeting in-stream water quality standards in that area.

While EPA recognizes Utah's requirement of Level III treatment by July, 1980, Federal funds to aid in the construction of wastewater treatment facilities to meet this deadline are limited. Presently, EPA does not have sufficient funds to provide 75 percent Federal funding of the estimated capital construction costs for providing Level III treatment for all proposed wastewater treatment facilities in the Utah Lake and Jordan River Basins. It is therefore necessary to determine the best possible way in which to utilize these limited Federal funds over the next few years to protect public health and to attain in-stream water quality standards.

The procedure required by the Federal Water Pollution Control Act for determining the best way to spend these Federal funds is the development of a funding priority list which is adopted every year by the State of Utah. Projects which are eligible for Federal funding are evaluated in accordance with specified policies and are then assigned a priority for receiving Federal funds. Projects with a high priority are the first to receive Federal funds. The policies used to evaluate and compare competing projects are very important in determining which projects receive funding priority.

EPA feels that there are alternative policies which should be considered in determining funding priorities for wastewater treatment projects in the Utah Lake and Jordan River Basins. EPA has identified two basic alternative policies which are discussed below. EPA encourages reviewers to comment upon the merits of the two policies and to suggest options which they may prefer.

The two basic alternative policies which EPA has identified regarding implementation of the Utah Lake-Jordan River Water Quality Management Plan are:

1) EPA can approve the Plan as recommended with Level III being the minimum treatment efficiency acceptable at all locations by 1980. The Plan would be implemented in accordance with the State's priority list as Federal funds become available. This option would provide Federal funds to upgrade treatment plants to the Level III treatment, considered necessary by the State of Utah to protect public health. However, since Federal funds are limited, some municipalities and sanitation districts would either have to absorb the additional cost of providing this Level III treatment to protect public health or delay upgrading treatment plants until Federal funds become available. Where secondary treatment is not now being achieved by a wastewater treatment plant, a delay in upgrading the treatment level may conflict with the Federal requirement of achieving secondary treatment by July, 1977.

2) EPA can conditionally approve the Plan whereby implementation occurs in accordance with the following general priorities. First funding priority is given to upgrading treatment plants to secondary treatment or to advanced levels of treatment (Level III, etc.) where necessary to attain in-stream water quality standards or where advanced treatment is found to be the most cost-effective wastewater treatment alternative. Second funding priority would be given to providing advanced treatment where an improvement in water quality is demonstrated in conjunction with control of non-point pollution sources. Third priority for funding advanced treatment would be given to those situations which do not fit the first two priority classes. This option would spread the limited Federal funds among more projects on a priority basis, by first providing funds for Level III treatment only where such treatment is needed to attain in-stream water quality standards or where Level III treatment is shown to be the most cost-effective alternative. However, this option might require some municipalities and sanitation districts to upgrade treatment plants to secondary treatment now, and in a few years upgrade to Level III.

A decision on these alternative courses of action will be made in the final environmental impact statement after considering all comments received on this draft statement.

GLOSSARY OF ABBREVIATIONS

- BOD - Biochemical Oxygen Demand
- CO - Carbon Monoxide
- mg/l - milligrams per liter
- MPN/100 ml - Most probable number of organisms per 100 milliliters
- NO_3 - Nitrates
- ppm - parts per million
- PO_4 - Phosphates
- SIP - Utah State Implementation Plan for attainment of national ambient air quality standards.
- TDS - Total Dissolved Solids
- TN - Total Nitrogen
- TSP - Total Suspended Particulates
- TSS - Total Suspended Solids
- ug/m^3 - micrograms per cubic meter

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